See the possibilities

User's Manual

AD-130GE

Digital 2CCD Progressive Scan
Multi-Spectral Camera

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Notice

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Warranty

For information about the warranty, please contact your factory representative.

Certifications

CE compliance

As defined by the Directive 2004/108/EC of the European Parliament and of the Council, EMC (Electromagnetic compatibility), JAI Ltd., Japan declares that AD-130GE complies with the following provisions applying to its standards.
EN 61000-6-3 (Generic emission standard part 1)
EN 61000-6-2 (Generic immunity standard part 1)

FCC

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Warning

Changes or modifications to this unit not expressly approved by the party responsible for FCC compliance could void the user's authority to operate the equipment.

Supplement

The following statement is related to the regulation on “ Measures for the Administration of the control of Pollution by Electronic Information Products “ , known as “ China RoHS “. The table shows contained Hazardous Substances in this camera.

mark shows that the environment-friendly use period of contained Hazardous Substances is 15 years.

重要注意事项

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根据中华人民共和国信息产业部『电子信息产品污染控制管理办法』，本产品《 有毒，有害物质或元素名称及含量表 》如下.

部件名称	有毒有害物质或元素					
	铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 (Cr(VI))	多溴联苯 (PPB)	多溴二苯醚 (PBDE)
螺丝固定座	×	○	○	○	○	○
光学滤色镜	×	○	×	○	○	○
连接插头	×	○	○	○	○	○
电路板	×	○	○	○	○	○
....	....	....	....	....	....	....

○：表示该有毒有害物质在该部件所有均质材料中的含量均在SJ/T11363-2006规定的限量要求以下。
×：表示该有毒有害物质至少在该部件的某一均质材料中的含量超出SJ/T11363-2006规定的限量要求。
（企业可在此处、根据实际情况对上表中打“×”的技术原因进行进一步说明。）

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数字「15」为期限15年。

Table of Contents

JAI GigE® Vision Camera operation manuals

To understand and operate this JAI GigE® Vision camera properly, JAI provides the following manuals.

User's manual (this booklet)	Describes functions and operation of the hardware
JAI SDK & Control Tool User Guide	Describes functions and operation of the Control Tool
JAI SDK Getting Started Guide	Describes the network interface

User's manual is available at www.jai.com
JAI SDK & Control Tool User Guide and JAI SDK Getting Started Guide are provided with the JAI SDK which is available at www.jai.com.

Introduction

GigE Vision is the new standard interface using Gigabit Ethernet for machine vision applications and it was mainly set up by AIA (Automated Imaging Association) members. GigE Vision is capable of transmitting large amounts of uncompressed image data through an inexpensive general purpose LAN cable for a long distance.

GigE Vision also supports the GenICam™ standard which is mainly set up by the EMVA (European Machine Vision Association). The purpose of the GenICam standard is to provide a common program interface for various machine vision cameras. By using GenICam, cameras from different manufactures can seamlessly connect in one platform.

For details about the GigE Vision standard, please visit the AIA web site, www.machinevisiononline.org and for GenICam, the EMVA web site, www.genicam.org.

JAI GigE Vision cameras comply with both the GigE Vision standard and the GenICam standard.

Before using GigE Vision camera

All software products described in this manual pertain to the proper use of JAI GigE Vision cameras. Product names mentioned in this manual are used only for the explanation of operation. Registered trademarks or trademarks belong to their manufacturers.
To use the JAI SDK, it is necessary to accept the "Software license agreement" first.

This manual describes necessary equipment and the details of camera functions.

Software installation

The JAI GigE Vision SDK & Control Tool can be downloaded from the JAI web site at www.jai.com. The JAI SDK is available for Windows XP and Vista, 32-bit and 64-bit.
For the details of software installation, please refer to the "Getting Started Guide" supplied on the JAI SDK download page.

Camera Operation
1. General
This manual covers the digital 2-CCD progressive scan multi-spectral camera AD-130GE.

The AD-130GE is a GigE Vision compliant camera, belonging to the JAI C3 Advanced family. The AD-130GE employs 2 CCDs, one for Bayer color and the other for NIR monochrome utilizing prism optics so that the AD-130GE can inspect the objects by visible color sensor and Near IR sensor with the same angle of view.

The AD-130GE provides a frame rate of 31 frames/second at full resolution. Using partial scan, the camera can achieve faster frame rates up to 145 fps (8 lines height).

The 1/3" CCDs with square pixels offer a superb image quality. The high-speed shutter function and asynchronous random trigger mode allows the camera to capture high quality images of fast moving objects.

The camera features a built-in pre-processing function which includes blemish compensation, shading compensation, Bayer to RGB interpolation, LUT/gamma correction and knee control.

The AD-130GE also complies with the GenICam standard and contains an internal XML file that is used to describe the functions/features of the camera. For further information about the GigE Vision Standard, please go to www.machinevisiononline.org and about GenICam, please go to www.genicam.org.

As an application programming interface, JAI provides an SDK (Software Development Kit). This SDK includes GigE Vision Filter Driver, JAI Control tool, software documentation and code examples.
The JAI SDK can be downloaded from www.jai.com.

The latest version of this manual can be downloaded from www.jai.com

For camera revision history, please contact your local JAI distributor.

2. Camera nomenclature
The standard camera composition consists of the camera main body and C-mount protection cap.

The camera is available in the following versions:

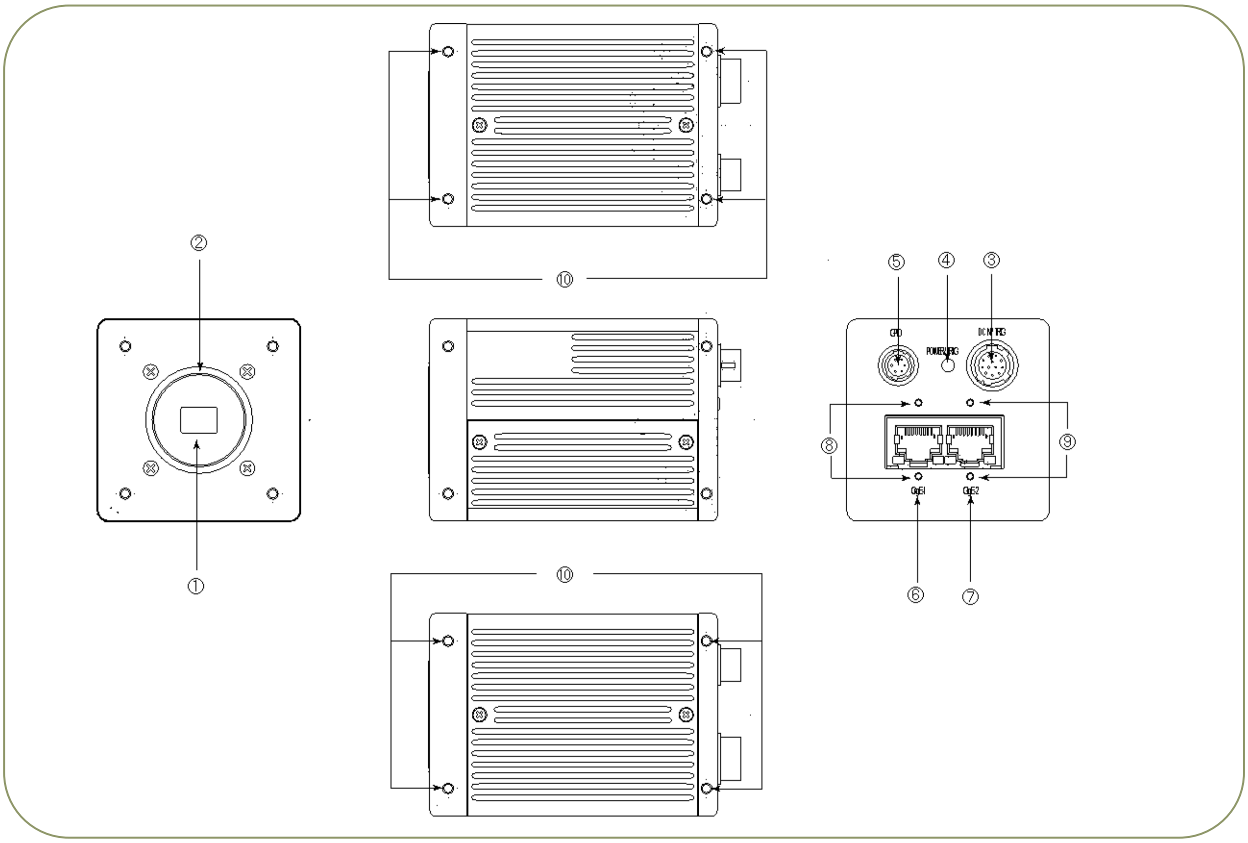
AD-130GE
Where **A** stands for "Advanced" family, **D** stands for "Dual CCD", **130** represents the resolution "1.3 million pixels", **130** indicates that this is the first dual-CCD model with this resolution, and **GE** stands for "GigE Vision" interface.

3. Main Features

- C3 Advanced series progressive scan camera
- GigE Vision, GenICam compliant
- Multi-spectral 2-channel CCD camera
- Simultaneously captures Visible and Near-IR through the same optical path
- 1/3” progressive scan IT CCDs with 1296 (h) x 966 (v) active pixels
- 3.75 μm square pixels
- RGB 24-bit or 32-bit or Raw Bayer 12- or 10- or 8-bit output for visible
- 12- or 10- or 8-bit output for Near-IR
- 30 frames/second with full resolution
- Variable partial scan is available with user-definable height and starting line
- Programmable exposure from 0.4L(11.49μs) to 982L(31.761ms)
- Edge Pre-select, Pulse Width Control and Reset Continuous trigger modes
- Sequence trigger mode for on-the –fly change of gain, exposure and ROI
- Delayed read out mode for smooth transmission of multi camera applications
- Blemish compensation built in
- Shading compensation circuit built in
- LUT (Look Up Table) for gamma correction
- AGC (Automatic Gain Control) from 0dB to 21dB
- LVAL synchronous/asynchronous operation (auto-detect)
- Auto-iris lens video output for lens control
- Programmable GPIO with opto-isolated inputs and outputs
- Comprehensive software tools and SDK for Windows XP/Vista/7 (32 bit “x86” and 64 bit “x64” JAI SDK Ver. 1.2.1 and after)

4. Locations and functions

4.1. Locations and functions



①	CCD sensor	: 1/3 inch CCD sensor
②	Lens Mount	: C-mount (Note*1)
③	12P Multi Connector	: DC+12V and Trigger Input
④	LED	: Power and Trigger indications
⑤	6P Multi Connector	: LVDS IN and TTL IN and OUT
⑥	RJ-45 Connector(GigE 1)	: GigE Vision I/F w/ thumbscrews for color
⑦	RJ-45 Connector(GigE2)	: GigE Vision I/F w/ thumbscrews for NIR
⑧	Holes for RJ-45 thumbscrews	: Vertical type (Note*2)
⑨	Holes for RJ-45 thumbscrews	: Vertical type (Note *2)
⑩	Mounting holes	: M3, max length 5mm (Note*3)

*1) : AD-130GE is based on a Dichroic Prism. For optimal performance, lenses designed for 3CCD cameras should be used with this camera. Be sure to avoid lenses that contain IR filters as this will impair the operation of the NIR sensor. Rear protrusion of the C-mount lens must be less than 4mm to avoid damage to the prism.

*2) : When an RJ-45 cable with thumbscrews is connected to the camera, please do not excessively tighten screws by using a screw driver. The RJ-45 receptacle on the camera might be damaged. For security, the strength to tighten screws is less than 0.147 Newton meter (Nm). Tightening by hand is sufficient in order to achieve this.

*3) : The tripod adapter plate MP-41 can be used with AD-130GE

Fig.1 Locations

4.2. Rear Panel Indicator

The rear panel mounted LED provides the following information:

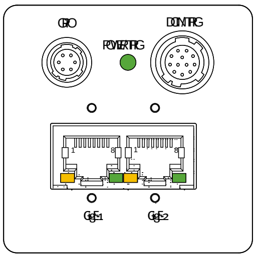


Fig.2 Rear

- ● Amber : Power connected – initiating
- ● Steady green : Camera is operating in Continuous mode
- ✱ Flashing green : The camera is receiving external trigger

- ■ Steady green : Connecting 1000Base-T : Link
- ✱ Flashing green : Connecting 100Base-T/10Base-T : Link
- ■ Amber : GigE Network:Act

panel

Note: In 10BASE-T connection, no signal is output.

5. Pin configuration & DIP switch

5.1. 12-pin Multi-connector (DC-in/GPIO/Iris Video)

Type: HR10A-10R-12PB
(Hirose) male.
(Seen from the rear of camera)

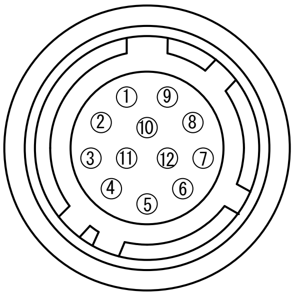


Fig. 3. 12-pin connector.

Pin no.	Signal	Remarks
1	GND	
2	+12 V DC input	
3	Opt IN 2 (-) / GND (*1)	GPIO IN / OUT
4	Opt IN 2 (+)/Iris Video out (*1)	
5	Opt IN 1 (-)	
6	Opt IN 1 (+)	
7	Opt Out 1 (-)	
8	Opt Out 1 (+)	
9	Opt Out 2 (-)	
10	Opt Out 2 (+)	
11	+ 12 V DC input	
12	GND	

*1: Iris Video output function can be set by the internal DIP switch (SW700).

5.2. Digital Output Connector for Gigabit Ethernet

Type: RJ-45 : HFJ11-1G02E-L21RL or equivalent

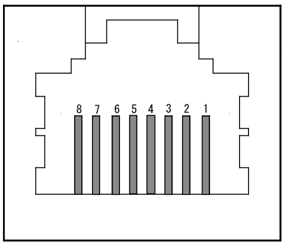


Fig. 4. Gigabit Ethernet connector

The digital output signals follow the Gigabit Ethernet interface using an RJ-45 conforming connector. To the right is a table with the pin assignment for Gigabit Ethernet connector.

Pin No	In/Out	Name
1	In/Out	MX1+ (DA+)
2	In/Out	MX1- (DA-)
3	In/Out	MX2+ (DB+)
4	In/Out	MX3+ (DC+)
5	In/Out	MX3- (DC-)
6	In/Out	MX2- (DB-)
7	In/Out	MX4+ (DD+)
8	In/Out	MX4- (DD-)

5.3. 6-pin Multi-connector (LVDS IN and TTL IN/OUT)

Type : HR-10A-7R-6PB

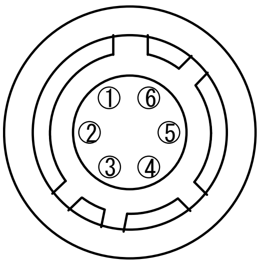
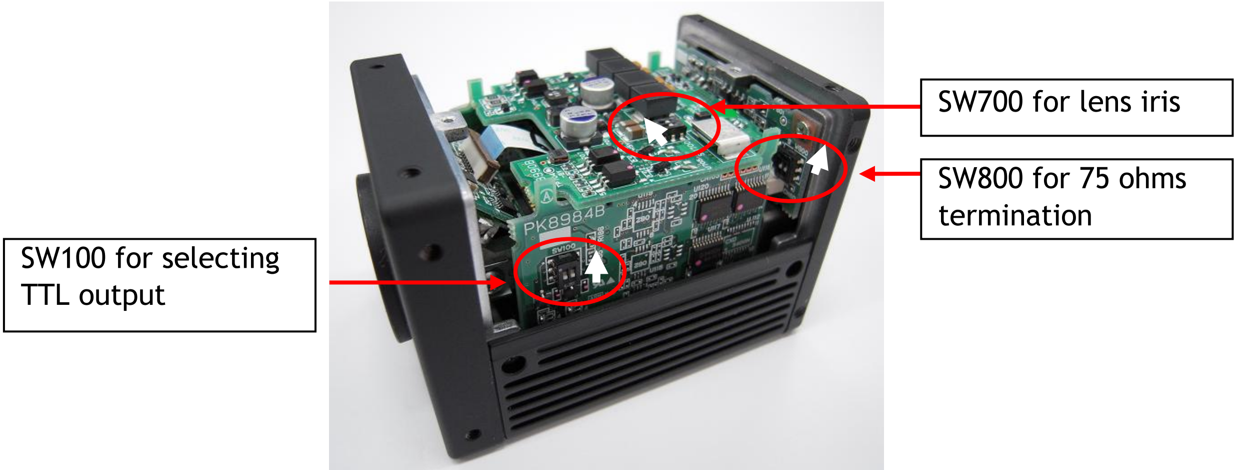


Fig.5 HIROSE 6-pin connector

No	I/O	Name	Note
1	I	LVDS In 1-	
2	I	LVDS In 1+	
3	I	TTL IN 1	75ohm Terminator (Note*1)
4	O	TTL Out 1	Note*2)
5	I	TTL IN 2	75ohm Terminator(Note*1)
6 注		GND	

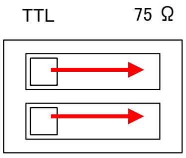
*1:can be changed by DIP switches.
*2: Open collector or TTL level can be selected by an internal DIP switch. Factory default is TTL.

5.4. DIP switches



5.4.1 SW800 Trigger input 75 ohms termination

Trigger input can be terminated with 75 ohms if DIP switch SW600 is selected as described below. Factory default is open.

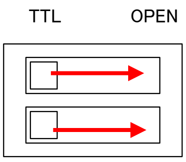


① TTL IN 1 Note: Toward upper side of camera body

② TTL IN 2

5.4.2 SW100 TTL/Open collector output select

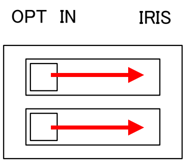
EEN output through HIROSE 6-pin #4 can be selected TTL level or open collector level. The selection is activated by DIP switch SW100 described below.



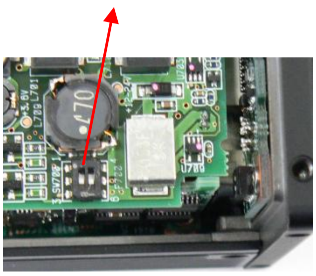
Note: Toward upper side of camera body

5.4.3 SW700 Video output for Auto iris lens

The output through HIROSE 12-pin #4 can be selected OPT IN 2 or Iris video output by DIP switch SW700 described below. Factory default is OPT IN 2.



Note: Toward inner side of camera body



6. System Configuration

6.1. System connection

When the AD-130GE is connected to a PC, there are two connection methods.
Method one is to use dual or quad input Network Interface Card (NIC) or two separate network interface cards. The other way is to use a hub as shown below.

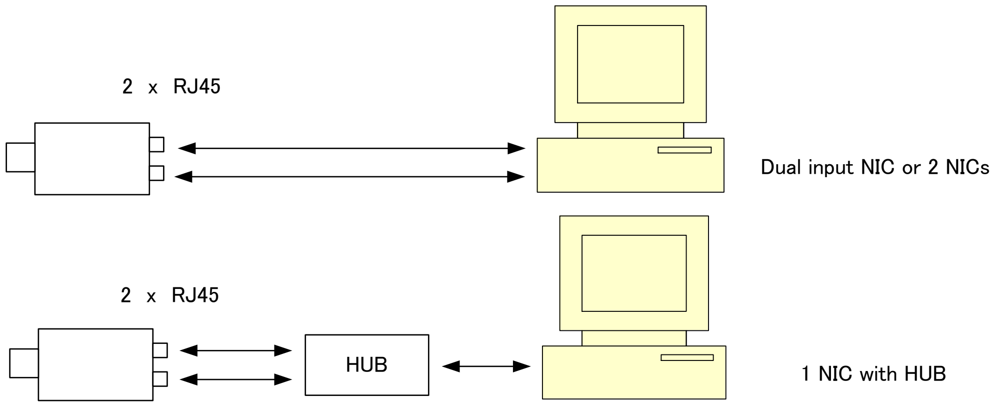


Fig.6 System configuration

It should be noted that the hub being used should comply with Gigabit Ethernet.
When JAI SDK control tool is started, AD-130GE is recognized as two cameras. #0 represents the Bayer color imager and #1 represents the NIR imager.
Each imager can be handled as an independent camera.



Two image sensors can be operated either in SYNC mode or ASYNC mode.
This can be set by the "Sync mode command".

6.2. RJ-45 outputs

The AD-130GE has two RJ-45 connectors, one for color sensor output and the other for the monochrome NIR sensor. The output for the color sensor is through GigE-1 and monochrome NIR output is through GigE-2. These two outputs can be set at synchronous (SYNC) or asynchronous (ASYNC) in Sync Mode feature.

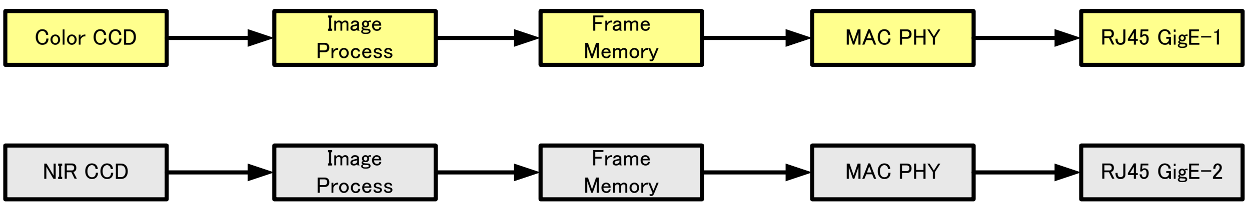
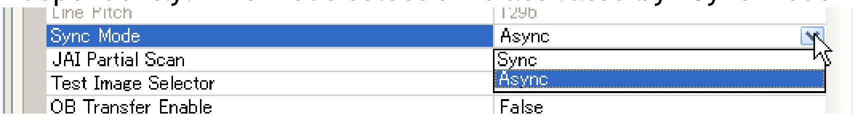


Fig.7 RJ-45 output system

6.3. Sync Mode

AD-130GE has two sensors inside and these two sensors can be synchronized or operated independently. This mode selection is activated by “Sync mode feature”.



Factory default setting is “Async”.

Sync mode	Video out (Pixel format)	Trigger in	Read out (Partial, Smearless)	Functions (Shutter,others)
Sync	Sensor 1 and 2 can be set independently	Trigger to sensor 1 operates sensor 2.	Settings to sensor 1 applies to sensor 2.	Sensor 1 and 2 can be set independently
Async		Input trigger to Sensor 1 and 2 independently	Sensor 1 and 2 can be set independently	

Functions	SYNC		ASYNC	
	RJ-45(GigE 1)	RJ-45(GigE 2)	RJ-45(GigE 1)	RJ-45(GigE 2)
Sensor	Bayer(sensor1)	NIR(sensor2)	Bayer(sensor1)	NIR(sensor2)
Trigger input	○	← Triggered by GigE1	○	○
Output	Bayer RGB	Monochrome	Bayer RGB	Monochrome
Shutter	○	○	○	○
Partial scan	○	← Follow the setting of GigE 1	○	○
Smearless	○	← Follow the setting of GigE 1	○	○

In Sync mode, the trigger to Bayer also triggers to NIR.

6.4. Lens considerations

The AD-130GE is based on a dichroic prism, allowing precise separation of the visible (color) and near-infrared parts of the spectrum. Thanks to the compact design of the prism, C-mount lenses can be used with this camera. For optimal performance it is strongly advised to use lenses designed for 3CCD cameras with the AD-130GE. These lenses have minimal chromatic aberration, thus allowing both the visible and near-IR images to be in focus. Be sure to select a lens that does not have any built-in IR filtering as this will disrupt the proper operation of the near-IR image channel.

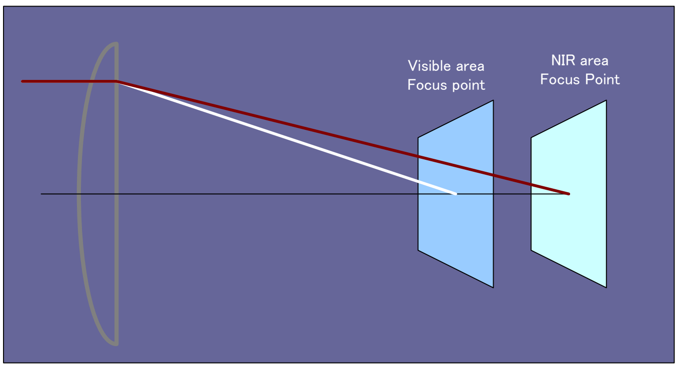


Fig 8 Focal points for Visible and NIR lights

7. Inputs and outputs interface

7.1. Overview

All input and output signals pass through the GPIO (General Purpose Input and Output) module. The GPIO module consists of a Look-Up Table (LUT – Cross-Point Switch), 2 Pulse Generators and a 12-bit counter. In the LUT, the relationship between inputs, counters and outputs is governed by internal register set-up.

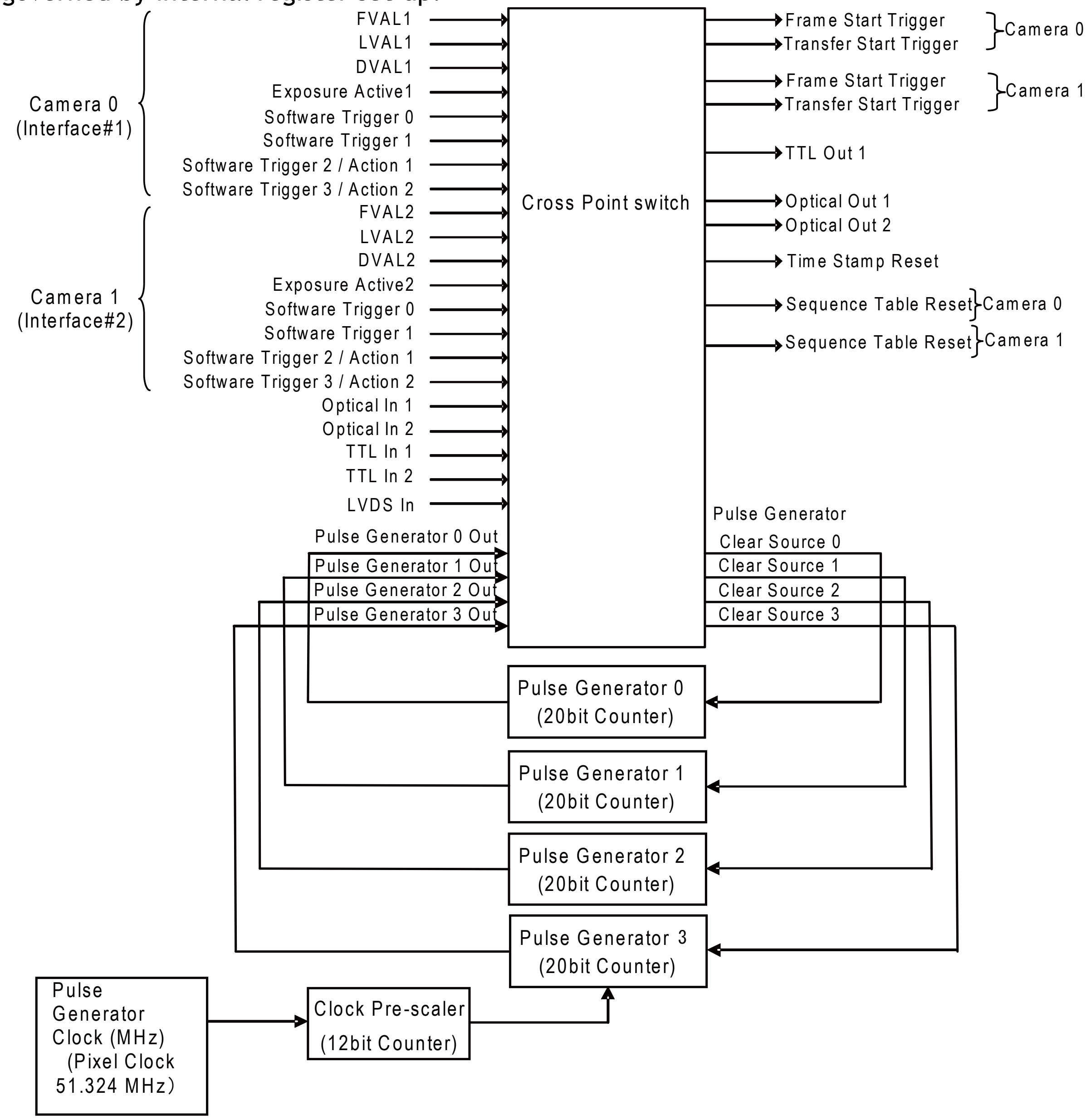


Fig. 9 Cross point switch

7.1.1 LUT (Cross Point Switch)

The LUT works as a cross-point switch which allows connecting inputs and outputs freely. The signals LVAL_IN, DVAL_IN, FVAL_IN and EEN_IN all originate from the camera timing circuit. On this diagram, Trigger 0 is used for exposure and Trigger 1 is used for Delayed Readout. The Time Stamp Reset signal can reset the time stamp specified in GigE Vision Format. This signal can be used when time stamps from several cameras connected are coincident with each other.

The “Sequence reset” resets the sequential settings. Outputs from the LUT described on the right side show GPIO settings for LINE SELECTOR in the JAI Camera Control tool and inputs to the LUT on the left side show GPIO settings for LINE SOURCE in the JAI Camera Control tool.

7.1.2 12-bit Counter

A camera pixel clock can be used as a source. The counter has a “Divide by N”, where N has the range 1 through 4096, allowing a wide range of clock frequencies to be programmed. Setting value 0 is bypass, setting value 1 is 1/2 dividing, and setting value 4095 is 1/4096 dividing. As the pixel clocks for the AD-130GE are 51.324 MHz, the output frequency is varied from 51.324 MHz to 12.53 KHz.

7.1.3 Pulse Generators (0 to 3)

Each pulse generator consists of a 20-bit counter. The behavior of these signals is defined by their pulse width, start point and end point.
The pulse generator signals can be set in either triggered or periodic mode.
In triggered mode, the pulse is triggered by the rising edge/falling edge/high level or low level of the input signal. In periodic mode, the trigger continuously generates a signal that is based on the configured pulse width, starting point and end point.

7.2. Opto-isolated Inputs/Outputs

The control interface of the C3 GigE Vision camera series has opto-isolated inputs and outputs, providing galvanic separation between the camera’s inputs/outputs and peripheral equipment. In addition to galvanic separation, the opto-isolated inputs and outputs can cope with a wide range of voltages; the voltage range for inputs is +3.3V to +24V DC whereas outputs will handle +5V to +24V DC.

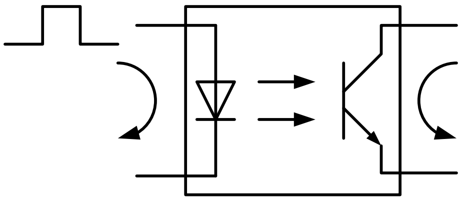


Fig.10 Photo coupler

7.2.1 Recommended External Input circuit diagram for customer

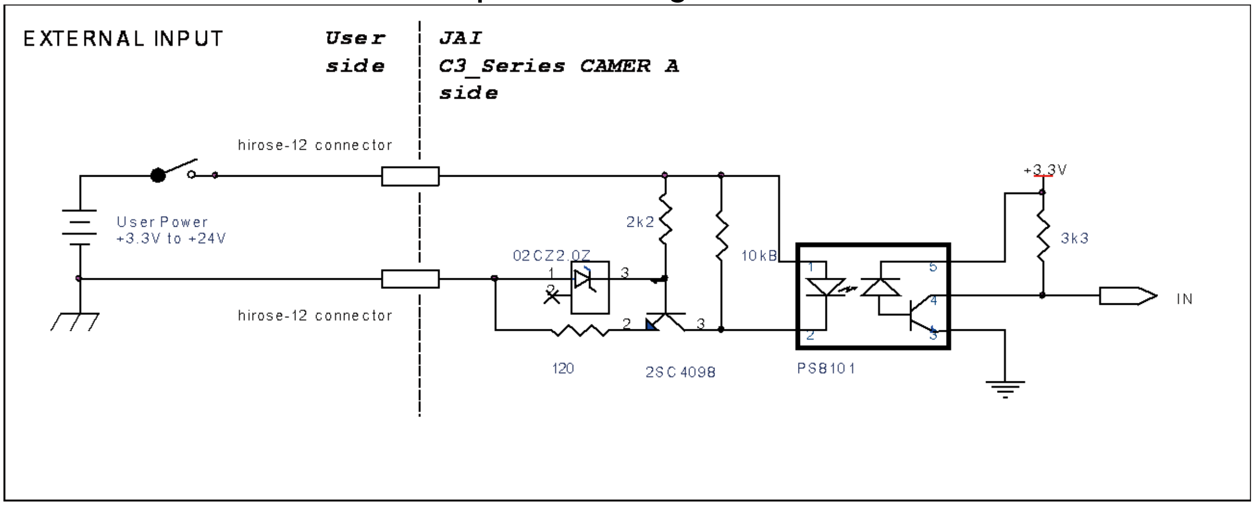


Fig.11 External Input Circuit、OPT IN 1 and 2

7.2.2 Recommended External Output circuit diagram for customer

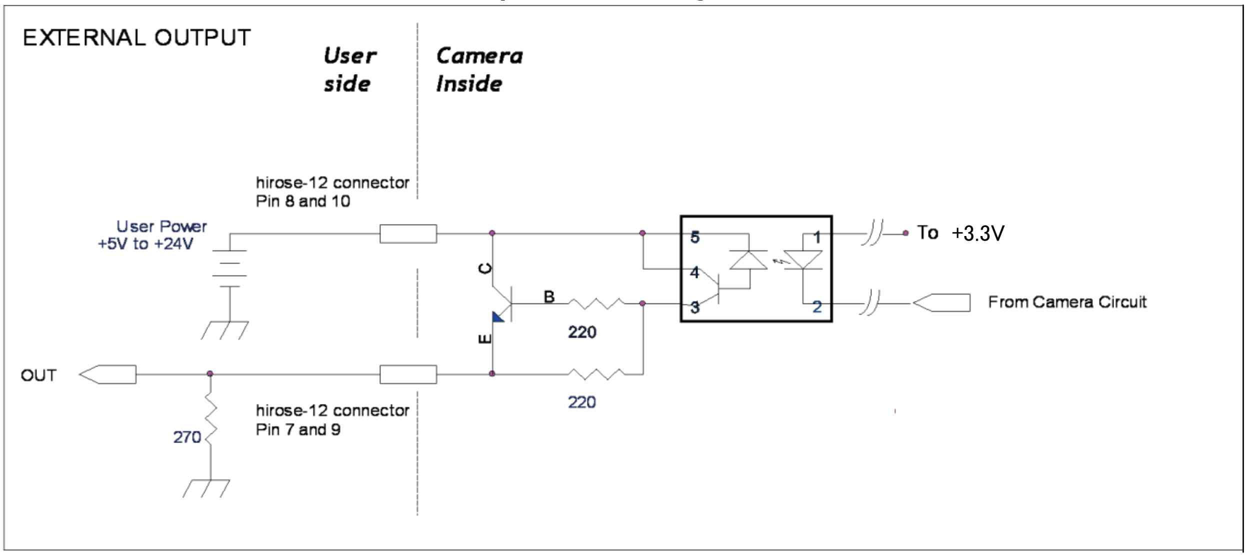
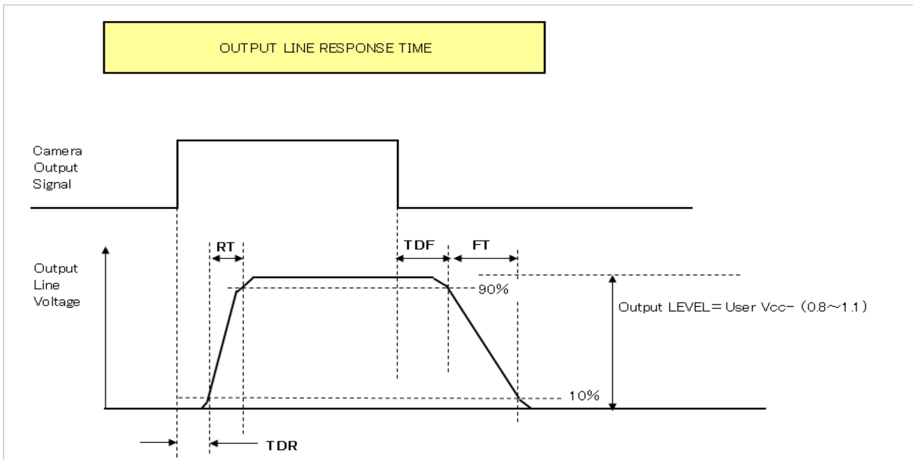


Fig.12 External Output Circuit, OPT OUT 1 and 2

7.2.3 Optical Interface Specifications

The relation of the input signal and the output signal through the optical interface is as follows.



Conditions for Input	
Input Line Voltage Range	+3.3V ~ +24V
Input Current	6mA ~ 30mA
Minimum Input Pulse Width to Turn ON	0.5μs

Output Specifications	
Output Load(Maximum Current)	100mA
Minimum Output Pulse Width	20μs
Time Delay Rise TDR	0.5μs ~ 0.7μs
Rise Time RT	1.2μs ~ 3.0μs
Time Delay Fall TDF	1.5μs ~ 3.0μs
Fall Time FT	4.0μs ~ 7.0μs

Fig.13 Optical Interface Performance

7.3. Input and output circuits

In the following schematic diagrams the input and output circuits for video and timing signals are shown.

7.3.1 Iris Video output

This signal can be used for lens iris control in Continuous mode. The signal is taken from the CCD sensor output through the process circuit but as the reverse compensation is applied, the signal is not influenced by the gain settings. The video output is without sync. The signal is 0.7 V p-p from 75 Ω without termination.
This signal is taken from sensor 1 but it can be changed by the register. In order to get this signal, DIP switch DSW700 should be changed. Refer to 5.4.3.

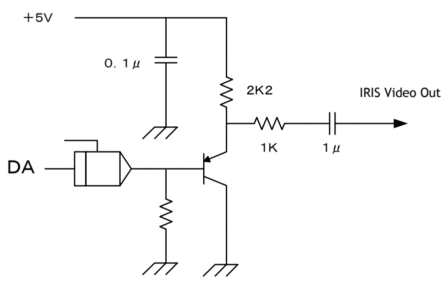


Fig.14 Iris video output

7.3.1.1 Iris Video input and output

The lens-iris video output level at pin 4 of the 12-pin Hirose connector is 700 mV for 100% video output level. The iris video signal is taken after the gain circuit. However, the negative compensation is applied to the iris circuit, thus gain setting has no influence for controlling auto iris lenses. It is without sync.

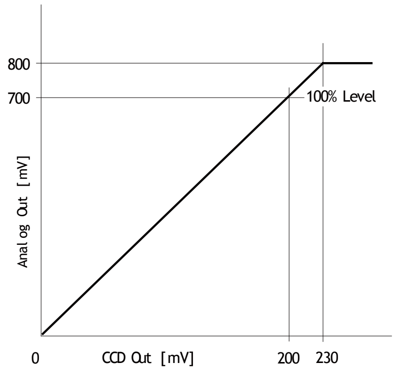
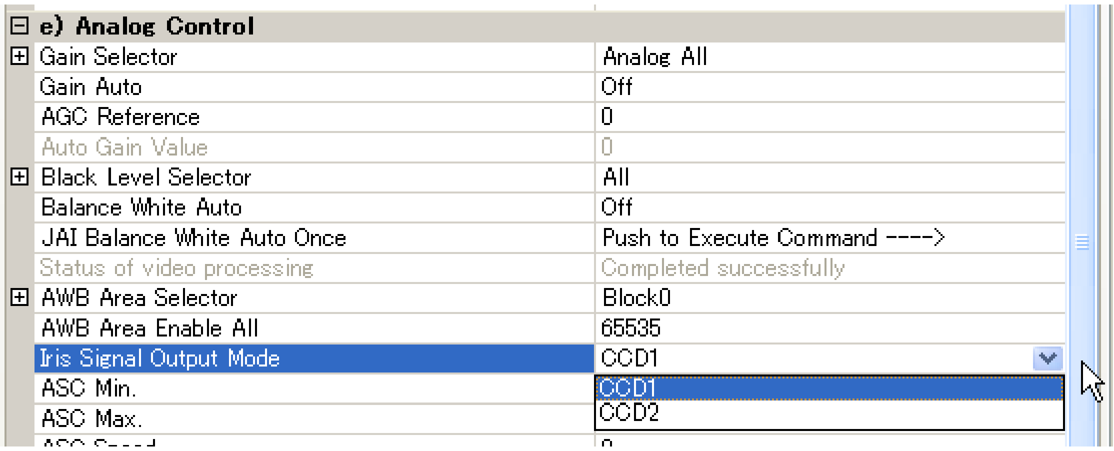


Fig.15 Iris Video output

7.3.1.2 Iris video output select

As the factory default setting, the signal from AD-130GE #0(color) is used for iris control. The setting can be changed in the following screen. This screen is effective if AD-130GE#0 is selected.



7.3.2 Trigger input

An external trigger input can be applied to pin 3 and 5 of 6-pin Hirose connector.
The input is AC coupled. To allow long pulses the input circuit is designed as a flip-flop circuit. The leading and trailing edges of the trigger pulse activate the circuit.
The trigger polarity can be changed.
Trigger input level 4 V ±2 V.

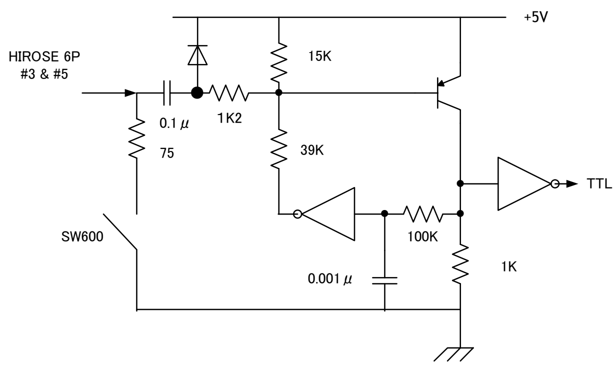


Fig.16 Trigger circuit

7.3.3 EEN (Exposure Enable) output

XEEN is available on pin 4 of the 6-pin Hirose connector.
The output can be selected as either open collector or TTL level.
The TTL output circuit is 75Ω complementary emitter followers. It will deliver a full 5 volt signal.
Output level ≥4 V from 75Ω. (No termination).
For the open collector, the maximum current is 120mA. But if current of more than 50mA is used, use thicker cable. The use of thinner cable may cause a malfunction due to its resistance.

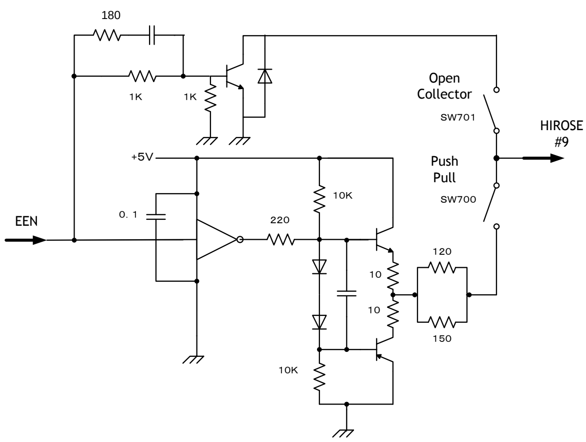


Fig.17 EEN output

7.4. GPIO Inputs and outputs table

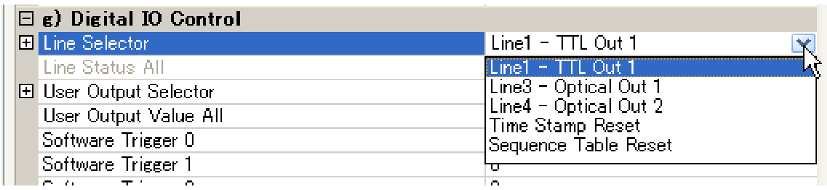
Source Signal (Cross Point Switch Input) \ Selector (Cross Point Switch Output)		Trigger Selector				Line Selector						Pulse Generator Selector			
		Camera 0		Camera 1						Camera 0	Camera 1				
		Frame Start	Transfer Start	Frame Start	Transfer Start	Line 1 TTL Out 1	Line 3 Optical Out 1	Line4 - Optical Out 2	Time Stamp Reset	Sequence Table Reset	Sequence Table Reset	Pulse Generator 0	Pulse Generator 1	Pulse Generator 2	Pulse Generator 3
Not Connected / Off		○	○	○	○	○	○	○	○	○	○	○	○	○	○
Line5 - Optical In 1		○	○	○	○	○	○	○	○	○	○	○	○	○	○
Line6 - Optical In 2		○	○	○	○	○	○	○	○	○	○	○	○	○	○
Line7 - TTL In 1		○	○	○	○	○	○	○	○	○	○	○	○	○	○
Line9 - TTL In 2		○	○	○	○	○	○	○	○	○	○	○	○	○	○
Line8 - LVDS In		○	○	○	○	○	○	○	○	○	○	○	○	○	○
Pulse Generator 0		○	○	○	○	○	○	○	○	○	○	×	○	○	○
Pulse Generator 1		○	○	○	○	○	○	○	○	○	○	○	×	○	○
Pulse Generator 2		○	○	○	○	○	○	○	○	○	○	○	○	×	○
Pulse Generator 3		○	○	○	○	○	○	○	○	○	○	○	○	○	×
Camera 0	Software Trigger 0	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Camera 1	Software Trigger 0	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Camera 0	Software Trigger 1	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Camera 1	Software Trigger 1	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Camera 0	Software Trigger 2	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Camera 1	Software Trigger 2	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Camera 0	Software Trigger 3	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Camera 1	Software Trigger 3	○	○	○	○	○	○	○	○	○	○	○	○	○	
Camera 0	Software	○	○	○	○	×	×	×	×	×	×	×	×	×	×
Camera 1	Software	○	○	○	○	×	×	×	×	×	×	×	×	×	×
Camera 0	Action 1	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Camera 1	Action 1	○	○	○	○	○	○	○	○	○	○	○	○	○	
Camera 0	Action 2	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Camera 1	Action 2	○	○	○	○	○	○	○	○	○	○	○	○	○	
FVAL1 (Interface#0)		×	×	×	×	○	×	×	×	×	×	○	○	○	○
LVAL1 (Interface#0)		×	×	×	×	○	×	×	×	×	×	○	○	○	○
DVAL1 (Interface#0)		×	×	×	×	○	×	×	×	×	×	○	○	○	○
Exposure Active1 (Interface#0)		×	×	×	×	○	○	○	×	×	×	○	○	○	○
FVAL2 (Interface#1)		×	×	×	×	○	×	×	×	×	×	○	○	○	○
LVAL2 (Interface#1)		×	×	×	×	○	×	×	×	×	×	○	○	○	○
DVAL2 (Interface#1)		×	×	×	×	○	×	×	×	×	×	○	○	○	○
Exposure Active2 (Interface#1)		×	×	×	×	○	○	○	×	×	×	○	○	○	○
		Trigger Source				Line Source						Pulse Generator Clear Source			

7.5. Configuring the GPIO module

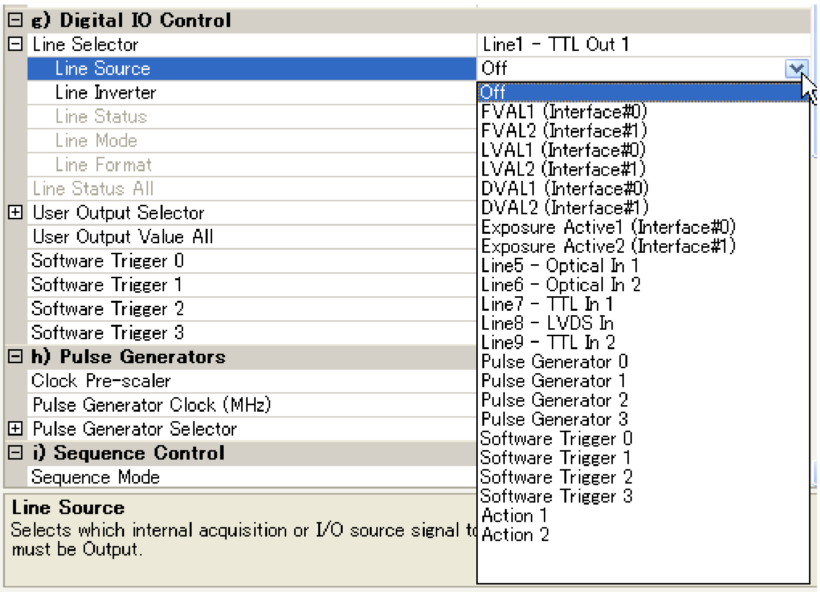
7.5.1 Input /Output Signal Selector

GPIO is used to determine which signal is assigned which terminal. For the details, please refer to Register Map, Digital I/O, Acquisition and Trigger Control and Pulse Generator.

Line Selector



Line Source



7.5.2 Pulse generators (20 bit x 4)

There are 4 pulse generators (designated 0 through 1) that can be used to create various timing scenarios by programming start point, endpoint, length and repeats.

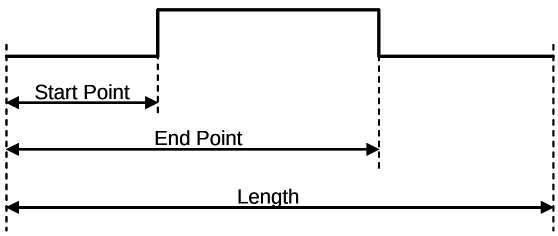
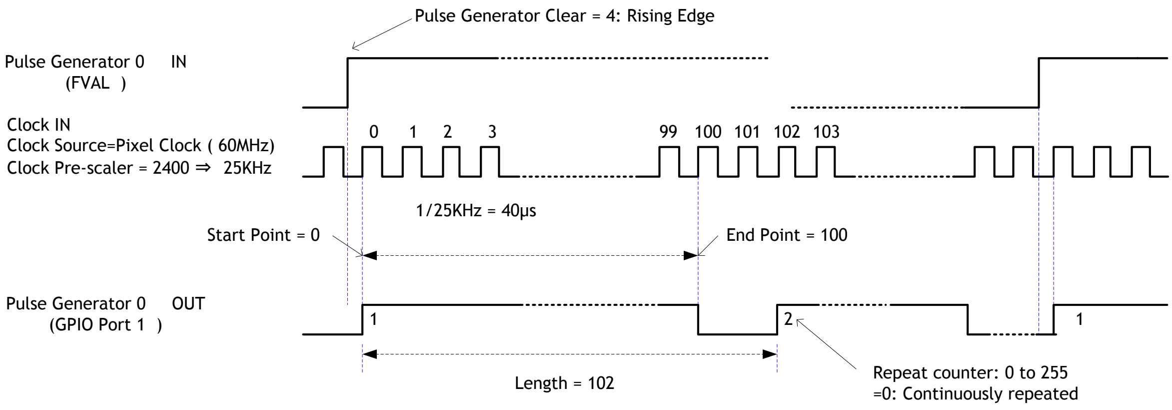


Fig.18 Pulse waveform

Example of the setting

The following drawing is an example of settings.
FVAL is used for the input of a pulse generator 0 and the clock, after the rising edge of FVAL, counts 100 clocks for the high period of the pulse and 102 clocks for the pulse length.
As 2400 is for Clock Pre-scaler, the output of the 12 bit counter is 25 KHz, which is 40μs.

Thus, pulse generator 0 creates a 4 ms pulse.



The following shows JAI SDK Camera Control Tool for setting Pulse Generators.

h) Pulse Generators	
Clock Pre-scaler	1
Pulse Generator Clock (MHz)	33.75
Pulse Generator Selector	Pulse Generator 0
Pulse Generator Length	1
Pulse Generator Length (ms)	2.963E-05
Pulse Generator Frequency (Hz)	3.375E+07
Pulse Generator Start Point	0
Pulse Generator Start Point (ms)	0
Pulse Generator End Point	1
Pulse Generator End Point (ms)	2.963E-05
Pulse Generator pulse-width (ms)	2.963E-05
Pulse Generator Repeat Count	0
Pulse Generator Clear Activation	Free Run
Pulse Generator Clear Source	Off
Pulse Generator Inverter(Polarity)	False

7.5.3 GPIO interface in GenICam standard

Outputs from Cross Point Switch are displayed in 3 sectors in GenICam standard.
Inputs to Cross Point Switch are displayed as Source in each sector.

(1) [Acquisition Control] - [Trigger Selector] - [Trigger Source]
: Select the trigger source for Frame Start and Transfer Start Trigger

(2) [Digital IO Control] - [Line Selector] - [Line Source]
: Select signal inputs and outputs for camera I/F

(3) [Pulse Generators] - [Pulse Generator Selector] - [Pulse Generator Clear Source]
: Select the signal source for CLEAR input to Pulse Generator

7.5.4 Change polarity

The polarity of AD-130GE is positive as the default setting.
This can be changed in each sector as follows.

(1) [Acquisition Control] - [Trigger Selector] - [Trigger Activation] and [Trigger Source Inverter]

In the AD-130GE, [Trigger Activation] and [Trigger Source Inverter] are changed simultaneously.

[Trigger Activation] =“Rising Edge”& [Trigger Source Inverter] =“False” settings are default.
The default setting can be changed to [Trigger Activation] =“Falling Edge”& [Trigger Source Inverter] = “True”.

If “Rising Edge” is set, the rising edge is effective input.
If “Falling Edge” is set, the falling edge is effective.

(2) [Digital IO Control] - [Line Selector] - [Line Inverter]

“False”is default setting. This can be changed to “True”.
If “False” is set, the signal selected in Line Source (Line Mode=Output) is directly connected to Line Selector.
If “True” is set, the signal selected in Line Source (Line Mode=Output) is connected to Line Selector after its polarity is reversed.

(3) [Pulse Generators] - [Pulse Generator Selector] - [Pulse Generator Inverter(Polarity)]

“False” is deafault and can be changed to “True”.
If “False” is set, the signal selected in Pulse Generator Clear Source is directly connected to Pulse Generator Selector.
If “True” is set, the signal selected in Pulse Generator Clear Source is connected to Pulse Generator Selector after its polarity is reversed.

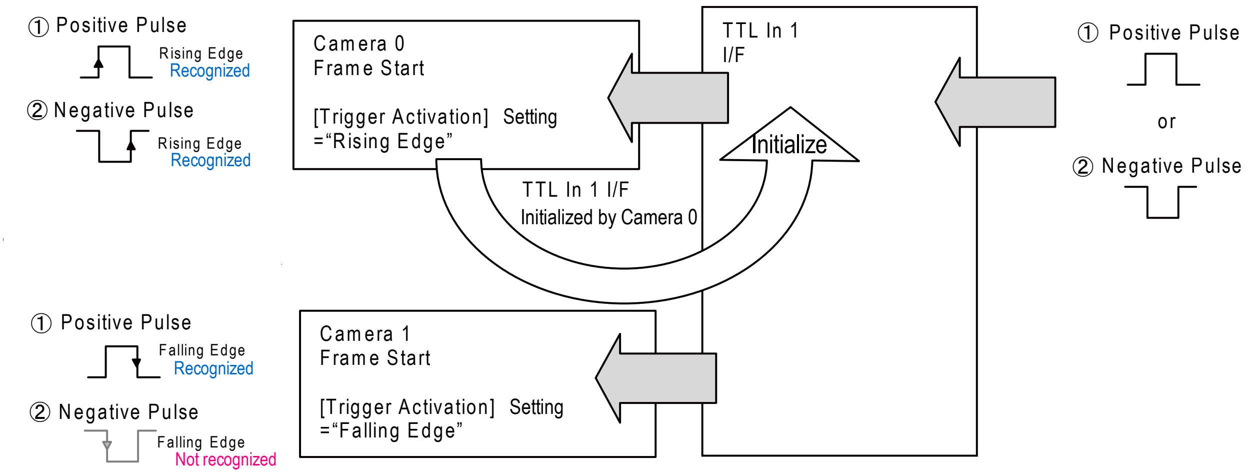
7.5.5 The restrictions to use TTL In I/F in the AD-130GE

If the polarity of TTL I/F in the AD-130GE is changed, the initialization is executed in the camera.
If the source for the same selector item of Camera 0 and Camera 1 is assigned TTL In1 and TTL In2 respectively, the initialization is executed without any problem.

However, if the source for the same selector item of Camera 0 and Camera 1 is assigned the same TTL In and the polarity is changed, there is some restriction as the initialization is executed using the Camera 0 polarity setting as the reference.

It is recommended to use a different sources for Camera 0 and Camera1.

Example of the restriction if the frame start trigger for Camera 0 and Camera 1 is set to TTL In1



[Restriction]
In Sync Mode = Async, TTL In1 I/F is initialized using Trigger Activation of Camera 0 as the reference. If the trigger set in Trigger Activation is applied to Camera 1 first, Camera 1 cannot recognize the trigger and misses one frame. (Case ②)

Fig. 19. Restriction by polarity setting

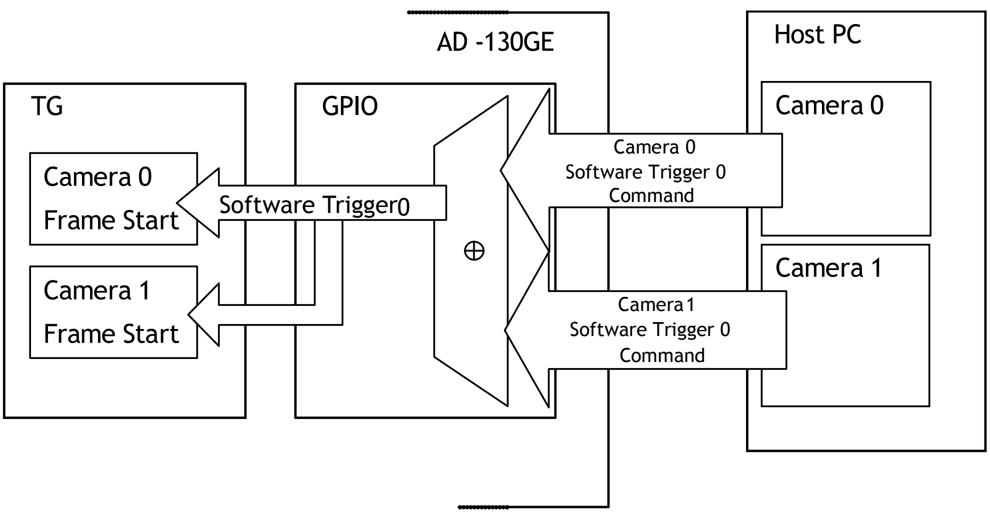
7.5.6 Caution when the software trigger is used

The AD-130GE has the following restriction when using the software trigger.

1) The input port of GPIO, Camera 0 and Camera 1 have software trigger 0 to 3, respectively. However, the output port of GPIO has only one software trigger 0 to 3. Therefore, the function is described in the figure 21.

   It is recommended to use a different software trigger for Camera 0 and Camera 1.

Example for Frame Start Trigger



> If Software trigger 0 is selected as the trigger source for Frame Start Trigger of Camera 0 and Camera 1, the command for Camera 0 and command for Camera 1 are mixed. Therefore, Software trigger 0 command for Camera 0 and Camera 1 are applied to both Camera 0 and Camera 1, and the function does not operate properly.

Fig. 20 Software Trigger setting restriction

2) Action Command
In the action command of AD-130GE, Software 2 and 3 are used as action commands and sent to the selected source.
If the source is set to Action 1, for instance, it is changed to Software trigger 2 in the camera control tool.
   Action 1 => Use Software Trigger 2
   Action 2 => Use Software Trigger 3

3) "Trigger Source = Software" in Frame Start and Transfer Start
For Frame Start and Transfer Start in the AD-130GE, "Trigger Source = Software" can be set and Software command 0 and software command 1 can be sent.
   Frame Start / Trigger Software command => Use Software Trigger 0
   Transfer Start / Trigger Software command => Use Software Trigger 1

7.6. GPIO programming examples

7.6.1 GPIO Plus PWC shutter

Example: 10μs unit pulse width exposure control (PWC). Pixel clock is 51.324MHz. 513 clocks (613-100) equal 10μs.

Feature			Value
c)Acquisition and Trigger controls	Trigger selector	Trigger Mode	ON
JAI Acquisition and Trigger Control	JAI Exposure Mode		Pulse width control
Pulse Generators	Pulse Generator selector	Pulse Generator 0 Selector	Line 5 =OPT IN 1
		Clock Choice	1 = Pixel Clock (51.324MHz)
		Counter Dividing Value	0 = Pass through
		Length Counter 0	1000 Clocks
		Start point Counter 0	100 Clocks
		Repeat Count 0	1
		End point Counter 0	613 Clocks
		Counter Clear 0	Rising Edge
		Trigger source	pulse generator 0

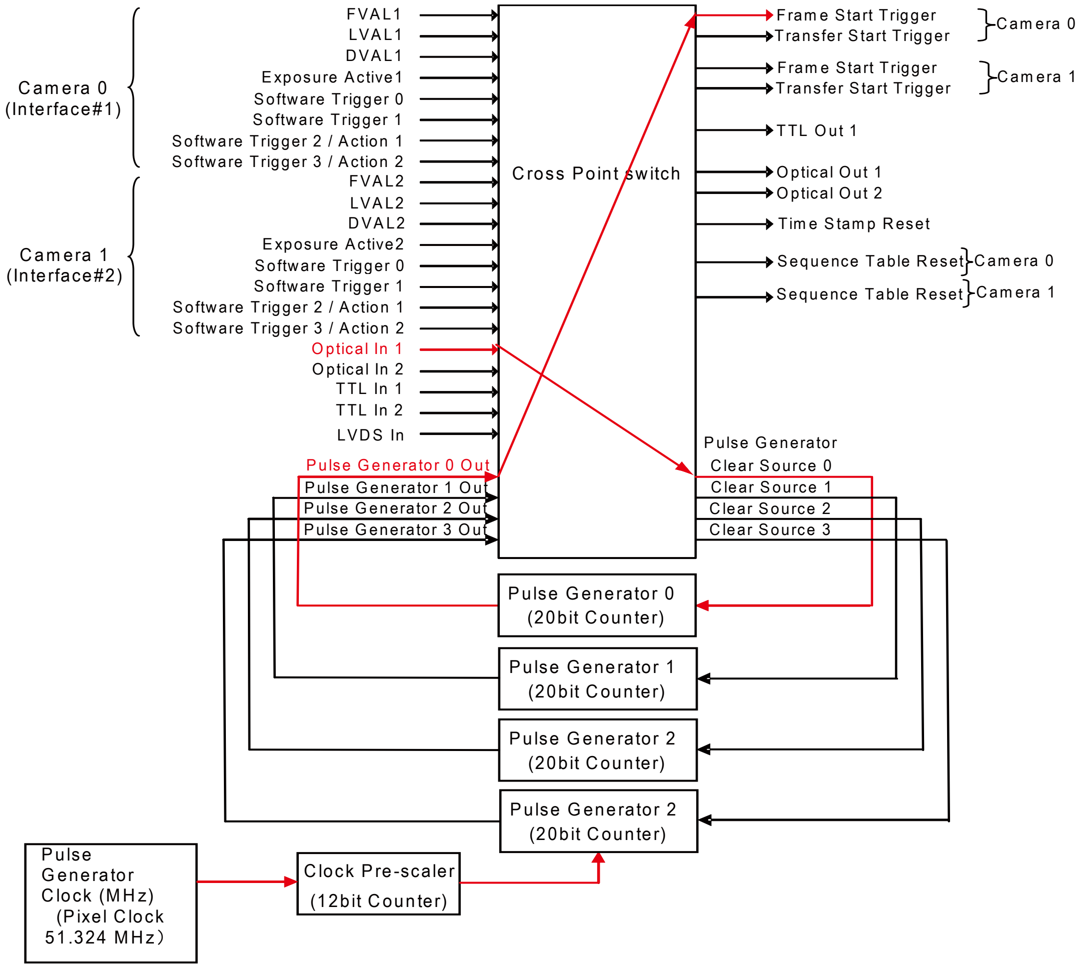


Fig.21 Pulse Generator Timing Example 1

7.6.2 Internal Trigger Generator

Example: Create a trigger signal and trigger the camera.

Feature			Value
c)Acquisition and Trigger controls	Trigger selector	Trigger Mode	ON
Pulse Generators	Pulse Generator selector	Pulse Generator 0 Selector	
		Clock Choice	1 = Pixel Clock (50MHz)
		Counter Dividing Value	2499 (51324000/2500)
		Length Counter 0	1000 Clocks
		Start point Counter 0	100 Clocks
		Repeat Count 0	0
		End point Counter 0	293 Clocks
		Clear activation	Off
		Trigger source	pulse generator 0

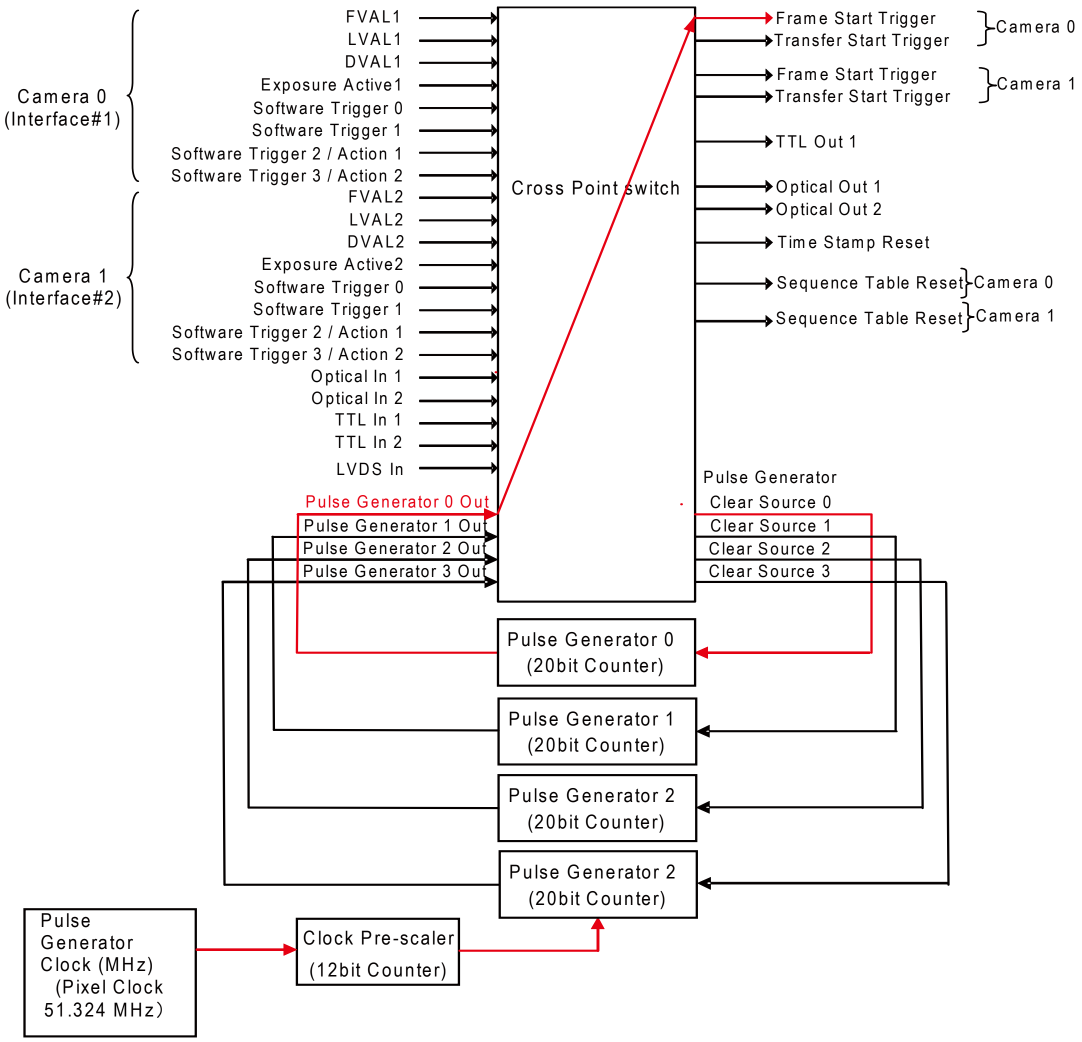
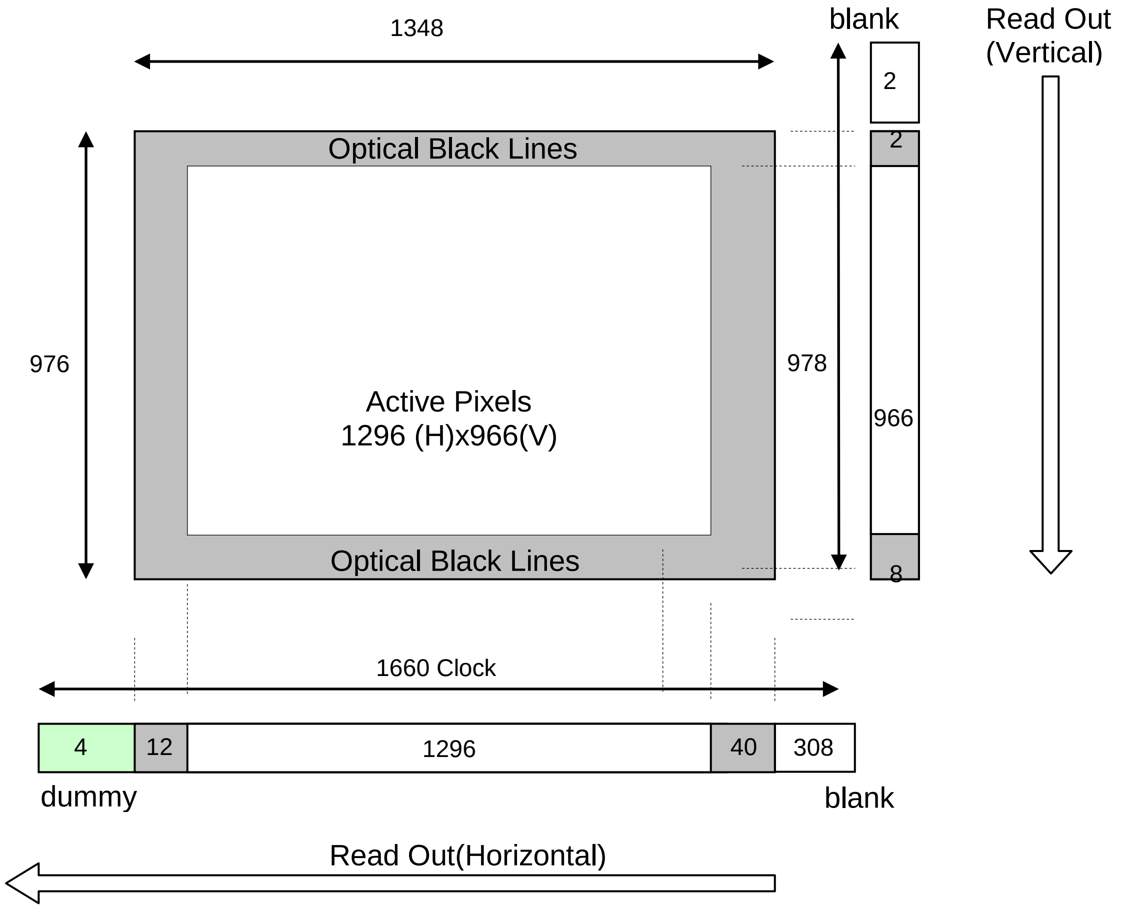


Fig.22 Pulse Generator 0 timing Example 2

8. Video Signal Output

8.1. Sensor layout



In the GigE Vision Format, only Active Pixel Area is output and the area of dummy and reserved is not output. If the OB transfer mode is set ON, OB parts of 8 pixels on the top and 16 pixels on the right are output.

Fig.23. Sensor layout and Video output image

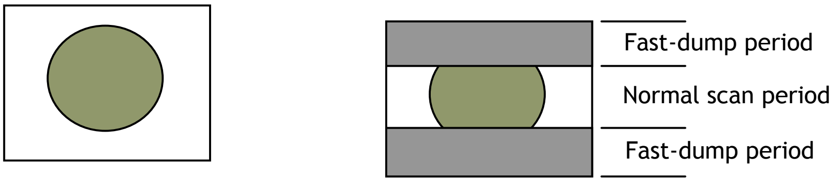
Note for output image:
The output area depends on the settings of Pixel Format as well as OB transfer Enable.
The available display image is indicated by "Width Max" and "Height Max" in the control tool.
The following table shows relations mentioned on the above.

	OB Transfer Enable ="False"		OB Transfer Enable ="True"	
	Width Max	Height Max	Width Max	Height Max
BayRG8,BayRG10,BayRG12, BayRG10_Packed,BayRG12_Packed, Mono8, Mono10, Mono12, Mono10_Packed,Mono12_Packed	1296	966	1312	970(Note1)
RGB8_Packed, BGR10V1_Packed, BGR10V2_Packed	1292(Note2)	962(Note2)	-	-

Note1: This is if JAI Partial Scan is set to "False". This will be 966, if JAI Partial Scan is set to "True"
Note2: In case of RGB output, 2 pixels each on both sides are not read out.

8.2. Partial scan (JAI Partial Scan ON)

Partial scan allows higher frame rates by reading out a smaller center portion of the image, reducing vertical resolution. This is particularly useful when inspecting objects that do not fill the whole height of the image. In order to activate this function, Fast Dump register should be ON.



Full scan　　　　Partial Scan

Fig.24 Conceptual drawing for partial scan

The partial scan mode for AD-130GE is variable. The first line and the last line to be read out can be set. For Bayer color, the start line should set on an odd line and the last line is set so that the height is an even number. It should be noted that if an even start line is set, the pixel format is automatically changed to GB pixel format.

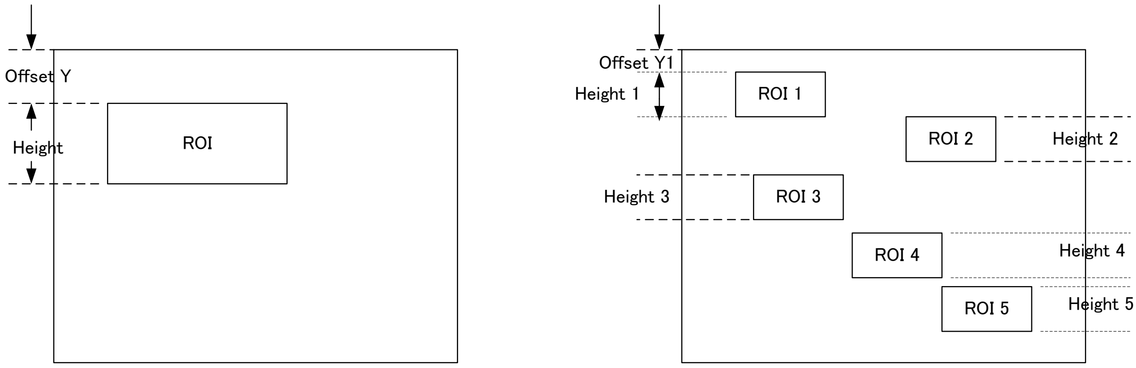
The variable scan readout is connected with the ROI settings.

1. If ROI is set, these settings are applied to the partial scan settings.
2. If the multi ROI is used, the smallest number of the line and the largest number of the line define the partial scan area.
3. In the case of sequence trigger, it is the same as for multi ROI. The smallest line and the largest line define the partial scan.

In order to execute the partial scan, the JAI Partial Scan should be ON.

1. The start line and end line if ROI is set

2,3 The start line and end line if Multi ROI is set.



Height 1+2+3+4+5 ≦ 966

Fig.25 Partial scan

8.3. Digital Video Output (Bit Allocation)

Although the AD-130GE is a digital camera, the image is generated by an analog component, the CCD sensor.
The table and diagram below show the relationship between the analog CCD output level and the digital output.

Color

CCD out	Analog Signal *	Bayer10bit	RGB24bit、Bayer8bit
Black	0mV	33.5LSB	8LSB
150mV	700mV	890LSB	222LSB
173mV ↑	800mV	1023LSB	255LSB

IR

CCD out	Analog Signal *	IR 10bit	IR 8bit
Black	0mV	33.5LSB	8LSB
200mV	700mV	890LSB	222LSB
230mV ↑	800mV	1023LSB	255LSB

The standard setting for 10-bit video level is 890 LSB. A 200 mV CCD output level equals 100% video output.

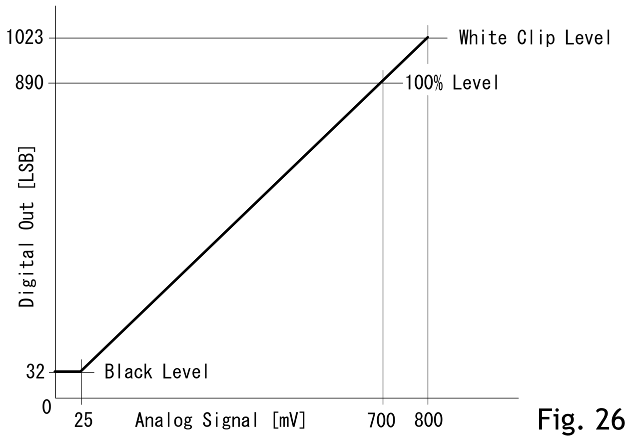


Fig. 26 Digital Output (10 bit output)

8.3.1 Bit Allocation (Pixel Format / Pixel Type) – (monochrome sensor)

In the GigE Vision Interface, GVSP (GigE Vision Streaming Protocol) is used for an application layer protocol relying on the UDP transport layer protocol. It allows an application to receive image data, image information and other information from a device.
As for the monochrome sensor in the AD-130GE, the following pixel types supported by GVSP are available.
With regard to the details of GVSP, please refer to the GigE Vision Specification available from the AIA (www.machinevisiononline.org).

8.3.1.1 GVSP_PIX_MONO8 (8bit)

1 Byte, 2 Byte, 3 Byte

Y0								Y1								Y2							
0	1	2	3	4	5	6	7	0	1	2	3	4	5	6	7	0	1	2	3	4	5	6	7

8.3.1.2 GVSP_PIX_MONO10 (10bit)

1 Byte, 2 Byte, 3 Byte, 4 Byte

Y0								Y0								Y1								Y1							
0	1	2	3	4	5	6	7	8	9	X	X	X	X	X	X	0	1	2	3	4	5	6	7	8	9	X	X	X	X	X	X

8.3.1.3 GVSP_PIX_MONO10_PACKED (10 bit)

1 Byte 2 Byte 3 Byte 4 Byte

Y0												Y1												Y2												Y3											
2	3	4	5	6	7	8	9	0	1	X	X	0	1	X	X	2	3	4	5	6	7	8	9	2	3	4	5	6	7	8	9	0	1	X	X	0	1	X	X	2	3	4	5	6	7	8	9

8.3.1.4 GVSP_PIX_MONO12 (12 bit)

1 Byte 2 Byte 3 Byte 4 Byte

Y0								Y0								Y1								Y1							
0	1	2	3	4	5	6	7	8	9	10	11	X	X	X	X	0	1	2	3	4	5	6	7	8	9	10	11	X	X	X	X

8.3.1.5 GVSP_PIX_MONO12_PACKED (12 bit)

1 Byte 2 Byte 3 Byte 4 Byte

Y0												Y1												Y2												Y3											
4	5	6	7	8	9	10	11	0	1	2	3	0	1	2	3	4	5	6	7	8	9	10	11	4	5	6	7	8	9	10	11	0	1	2	3	0	1	2	3	4	5	6	7	8	9	10	11

Connector	Value
RJ-45_2	Mono8 Mono10 Mono10 Packed Mono12 Mono 12 Packed

8.3.2 Bit Allocation (Pixel Format / Pixel Type) - (Bayer mosaic color sensor)

In the GigE Vision Interface, GVSP (GigE Vision Streaming Protocol) is used for an application layer protocol relying on the UDP transport layer protocol. It allows an application to receive image data, image information and other information from a device.
As for the Bayer mosaic color sensor in the AD-130GE, the following pixel types supported by GVSP are available.
With regard to the details of GVSP, please refer to the GigE Vision Specification available from the AIA.

8.3.2.1 GVSP_PIX_BAYRG8 "BayerRG8"

Odd Line

1 Byte 2 Byte 3 Byte

R0								G1								R2							
0	1	2	3	4	5	6	7	0	1	2	3	4	5	6	7	0	1	2	3	4	5	6	7

Even Line

1 Byte 2 Byte 3 Byte

G0								B1								G2							
0	1	2	3	4	5	6	7	0	1	2	3	4	5	6	7	0	1	2	3	4	5	6	7

8.3.2.2 GVSP_PIX_BAYRG10 “Bayer RG10”

Odd Line

1 Byte								2 Byte								3 Byte								4 Byte							
R0								R0								G1								G1							
0	1	2	3	4	5	6	7	8	9	X	X	X	X	X	X	0	1	2	3	4	5	6	7	8	9	X	X	X	X	X	X

Even Line

1 Byte								2 Byte								3 Byte								4 Byte							
G0								G0								B1								B1							
0	1	2	3	4	5	6	7	8	9	X	X	X	X	X	X	0	1	2	3	4	5	6	7	8	9	X	X	X	X	X	X

8.3.2.3 GVSP_PIX_BAYRG12 “Bayer RG12”

Odd Line

1 Byte								2 Byte								3 Byte								4 Byte							
R0								R0								G1								G1							
0	1	2	3	4	5	6	7	8	9	10	11	X	X	X	X	0	1	2	3	4	5	6	7	8	9	10	11	X	X	X	X

Even Line

1 Byte								2 Byte								3 Byte								4 Byte							
G0								G0								B1								B1							
0	1	2	3	4	5	6	7	8	9	10	11	X	X	X	X	0	1	2	3	4	5	6	7	8	9	10	11	X	X	X	X

8.3.2.4 GVSP_PIX_BAYRG10_Packed (Bayer10bit, Packed output)

Odd Line

R0												G0											
2	3	4	5	6	7	8	9	0	1	X	X	0	1	X	X	2	3	4	5	6	7	8	9

Even Line

G1												B0											
2	3	4	5	6	7	8	9	0	1	X	X	0	1	X	X	2	3	4	5	6	7	8	9

8.3.2.5 GVSP_PIX_BAYRG12_Packed （Bayer12bit, Packed output）

Odd Line

R0												G0											
4	5	6	7	8	9	10	11	0	1	2	3	0	1	2	3	4	5	6	7	8	9	10	11

Even Line

G1												B0											
4	5	6	7	8	9	10	11	0	1	2	3	0	1	2	3	4	5	6	7	8	9	10	11

8.3.2.4 GVSP_PIX_RGB8_PACKED “RGB 8Packed”

1 Byte								2 Byte								3 Byte							4 Byte
R0								G0								B0							
0	1	2	3	4	5	6	7	0	1	2	3	4	5	6	7	0	1	2	3	4	5	6	7

8.3.2.5 GVSP_PIX_RGB10V1_PACKED "RGB 10V1 Packed"

1 Byte								2 Byte								3 Byte								4 Byte							
R0		G0		B0				R0								G0								B0							
0	1	0	1	0	1	X	X	0	1	2	3	4	5	6	7	0	1	2	3	4	5	6	7	0	1	2	3	4	5	6	7

8.3.2.6 GVSP_PIX_RGB10V2_PACKED "RGB 10V2 Packed"

1 Byte								2 Byte								3 Byte								4 Byte							
R0										G0														B0							
0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	X	X

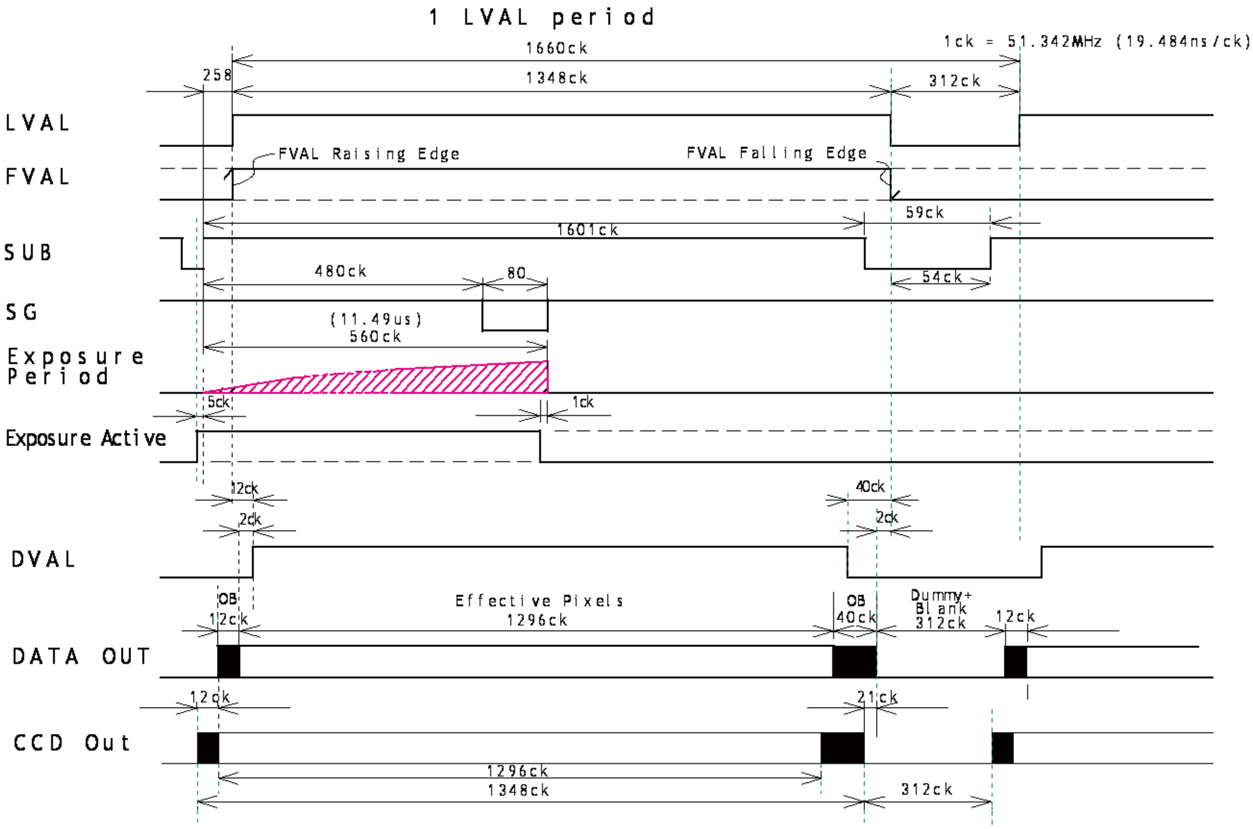
Connector	Value
RJ-45_1	BAYRG8 BAYRG10 BAYRG12 BAYRG10_Packed BAYRG12_Packed RGB8 RGB10V1Packed RGB10V2Packed

Note: If the start line of ROI is set at even line, GB pixel format is automatically output instead of RG pixel format.

8.4. Video timing

8.4.1 Horizontal Timing

The horizontal timing for Continuous mode, full frame and partial scan are shown below.
This is common for both Bayer color imager and monochrome IR imager.



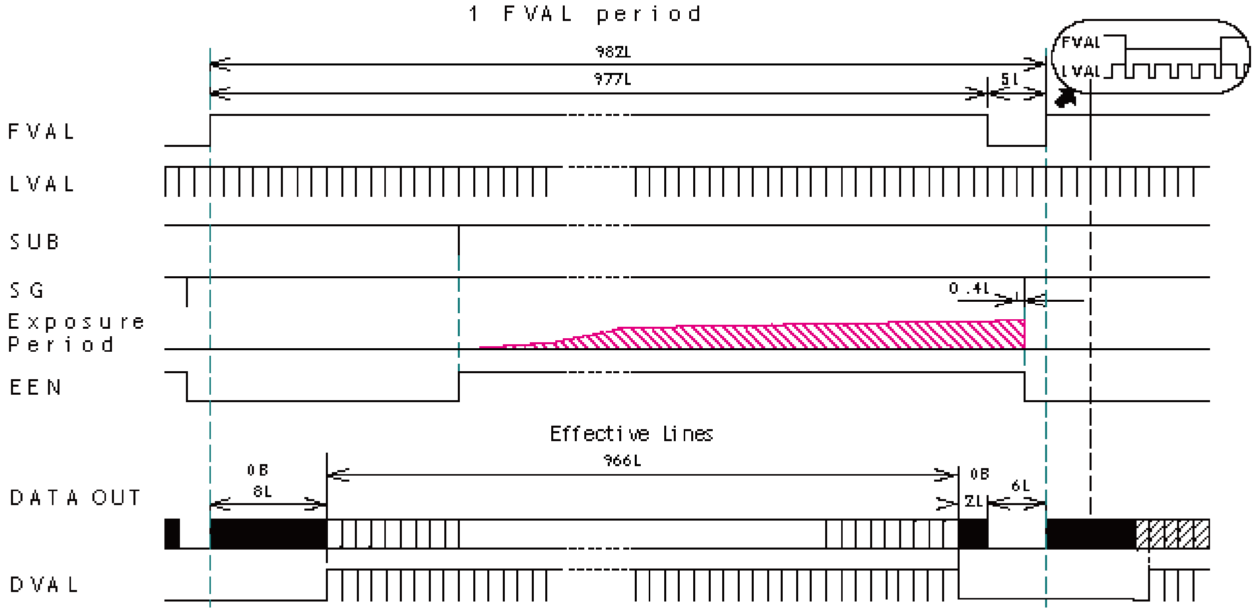
1 Clock =51.324MHz (19.48ns)
1CLK: 1 Pixel clock period OB: Optical black
LVAL is HIGH in the period of optical black and effective video periods
DVAL is HIGH in the effective video period

Fig.27 Horizontal Timing

8.4.2 Vertical Timing

The vertical timing for Continuous mode and full frame scan are shown below.
This is common for both Bayer color imager and monochrome IR imager

If JAI Partial Scan = False,



1L = 1660 clock (32.344µs)
1L : 1 LVAL period OB: optical black
FVAL is HIGH in the optical black and effective video periods
LVAL is always output
DVAL is output during the effective lines

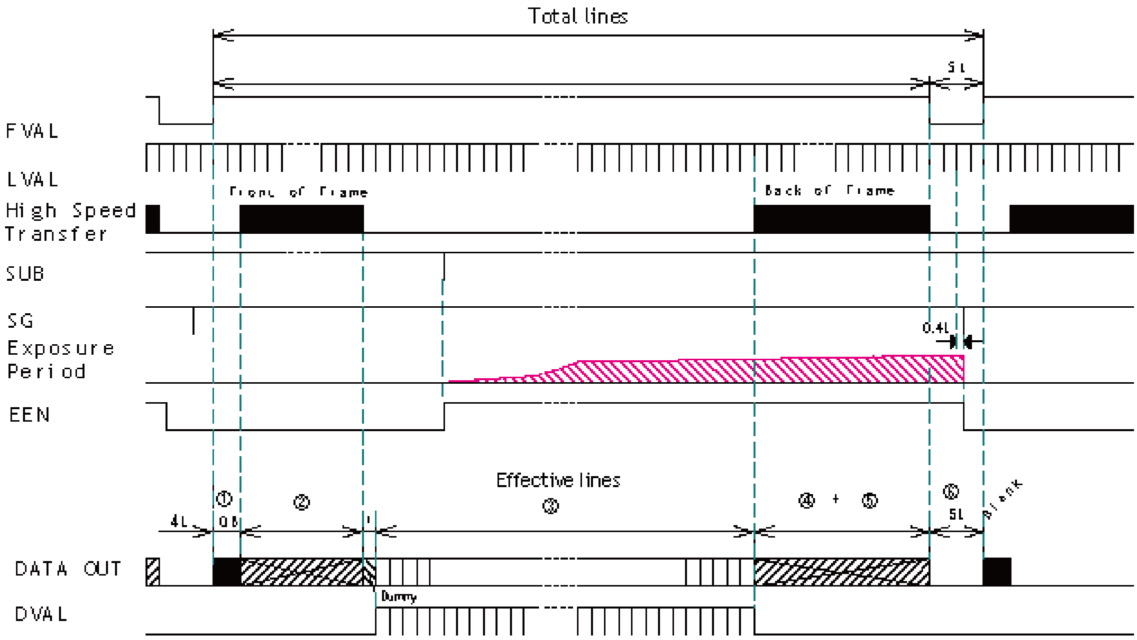
This timing chart shows camera timing. The output through GigE interface is only effective lines.

Fig.28 Vertical Timing

8.4.3 Partial Scan Vertical Timing

The following chart shows the vertical timing of partial scanning in the continuous mode. The horizontal timing for partial scan is the same as full scan. This is common for Channel 1 (visible, color) and Channel 2 (near-IR)

If JAI Partial Scan = True,



1L : 1LVAL period OB: Optical Black
1L = 1660 clock (32.344µs)

Fig.29 Vertical Timing for partial scan

How to calculate total line number and frame rate on variable partial scan mode

Partial scan Offset Y 0 line to 958 line
Height 8 lines to 966 lines

Total lines = ① + ② + ③ + ④ + ⑤ + ⑥

Where,

① OB period in the upper part of the frame= 4L

② Fast dump period for the upper part= *Round up* {(4+(Offset) - 1)/5}

③ Read out lines = Height + G

G=1, if Height is odd, G=0, if Height is even.

④ Fast dump period for the lower part=

Round up {((966 -(OffsetY)- (Height) +2))/5)

⑤ Even adjustment for total line=

⑤=1, If ①+②+③+④+⑥ is odd and ⑤=0, if ①+②+③+④+⑥ is even.

⑥ Dummy transfer period = 5L

Frame rate (fps) = Horizontal Frequency / Total lines

where, Horizontal Frequency 30.918KHz

Calculation example

Reference	JAI Partial Scan	Height	Offset Y	Total Line	FPS
Full Line	False	966	0	982	31.484
Full Line	True	966	0	978	31.613
Center 2/3 Partial	True	644	160	720	42.941
Center 1/2 Partial	True	482	242	590	52.403
Center 1/4 Partial	True	242	362	398	77.682
Center 1/8Partial	True	120	422	302	102.380
Center 8 Line	True	8	478	212	145.84

9. Network configuration

➲ **For details of the network settings, please refer to the "Getting Started Guide" supplied with the JAI SDK.**

9.1. GigE Vision Standard Interface

The AD-130GE is designed in accordance with the GigE Vision standard. Digital images are transmitted over Cat5e or Cat6 Ethernet cables. All camera functions are also controlled via the GigE Vision interface.

The camera can operate in Continuous mode, providing an endless stream of images. For capturing individual images related to a specific event, the camera can also be triggered. For precise triggering, it is recommended to use a hardware trigger applied to the Hirose 12-pin connector. It is also possible to initiate a software trigger through the GigE Vision interface. However, when using a software trigger, certain latency inherent to the GigE interface must be expected. This latency, which manifests itself as jitter, greatly depends on the general conditions and traffic on the GigE connection. The frame rate described in this manual is for the ideal case and may deteriorate depending on conditions.

When using multiple cameras (going through a switch and/or a single path) or when operating in a system with limited transmission bandwidth the Delayed Readout Mode and Inter-Packet Delay functions can be useful.

9.2. Equipment to configure the network system

9.2.1 PC

The PC used should have the following performance or better

1) Recommended CPU : Core2 Duo 2.4GHz or better,
   Better than Core2 Extreme
2) Recommended memory : 2Gbyte or more
3) Video card : Better than PCI Express Bus Ver.1.0 x16
   VRAM should be better than 256MByte, DDR2
4) Other : The resident software should not be used

9.2.2 Cables

GigEVision configures the system by using 1000BASE-T.
In the market, CAT5e (125MHz), CAT6 (250MHz) and CAT7 (600MHz) cables are available for 1000BASE-T. There are crossover cables and straight through cables available. Currently, as most equipment
complies with Auto MDI/MDI-X, please use straight through cables. (Among crossover cables, a half crossover type exists, which the Ethernet will recognize as 100BASE-T).

9.2.3 Network card (NIC)

The network card should comply with 1000BASE-T and also have the capability of JUMBO FRAMES. When the jumbo frame size is set at a larger number, the load on the CPU will be decreased. Additionally, as the overhead of the packet is decreased, the transmission will have more redundancy.

JAI confirms the following network cards.

NIC Manufacture	Type	PCI-X Bus	PCI-Express Bus	
Intel	PRO/1000MT Server Adapter	√	–	32bit or 64bit 33/66/100/133 MHz
Intel	PRO/1000MT Dual Port Server Adapter	√	–	32bit or 64bit 33/66/100/133 MHz
Intel	PRO/1000GT Quad Port Server Adapter	√	–	32bit or 64bit 66/100/133 MHz
Intel	PRO/1000PT Server Adapter	—	√ (x1)	2.5Gbps uni-directional 5Gbps bi-directional
Intel	Pro/1000 CT Desktop adaptor	—	√ (x1)	2.5Gbps uni-directional 5Gbps bi-directional
Intel	Gigabit ET2 Quad port Server Adapter	—	√ (x4)	10Gbps uni-directional 20Gbps bi-directional
Intel	Gigabit ET Dual port Server Adapter	—	√ (x4)	10Gbps uni-directional 20Gbps bi-directional
Intel	Gigabit EF Dual port Server Adapter	—	√ (x4)	10Gbps uni-directional 20Gbps bi-directional

9.2.4 Hub

It is recommended to use the metal chassis type due to the shielding performance. As the hub has a delay in transmission, please note the latency of the unit.

9.3. Recommended Network Configurations

Although the AM-800GE and AB-800GE conforms to Gigabit Ethernet (IEEE 802.3) not all combinations of network interface cards (NICs) and switches/routers are suitable for use with the GigE Vision compliant camera.
JAI will endeavor to continuously verify these combinations, in order to give users the widest choice of GigE components for their system design.

➲ **For details of the network settings, please refer to the "Getting Started Guide" supplied with the JAI SDK.**

9.3.1 Guideline for network settings

To ensure the integrity of packets transmitted from the camera, it is recommended to follow these simple guidelines:

1. Whenever possible use a peer-to-peer network.
2. When connecting several cameras going through a network switch, make sure it is capable of handling jumbo packets and that it has sufficient memory capacity.
3. Configure inter-packet delay to avoid congestion in network switches.
4. Disable screen saver and power save functions on computers.
5. Use high performance computers with multi-CPU, hyper-thread and 64-bit CPU, etc.
6. Only use Gigabit Ethernet equipment and components together with the camera.
7. Use at least Cat5e and preferably Cat6 Ethernet cables.
8. Whenever possible, limit the camera output to 8-bit.

9.3.2 Video data rate (network bandwidth)

The video bit rate for the AD-130GE in Continuous mode is:

Model	Pixel Type	Frame Rate	Packet (Packet 1500)
AD-130GE	MONO8	31Frame/s	328Mbit/s
	MONO10_PACKED MONO12_PACKED	31Frame/s	492Mbit/
	MONO10 MONO12	31Frame/s	655Mbit/s
	BAYRG8,(BAYGB8)	31Frame/s	328Mbit/s
	BAYRG10 Packed, (BAYGB10 Packed) BAYRG12 Packed, (BAYGB12 Packed)	31Frame/s	492Mbit/
	BAYRG10,(BAYGB10) BAYRG12,(BAYGB12)	31Frame/s	655Mbit/s
	RGB8	29.5rame/s	940Mbit/s
	BGR10V1, BGR10V2	22.1Frame/s	940Mbit/s

- In the case of using Jumbo Frames (16K), the packet data will be improved by 2%.

- **Note for setting packet size**

The packet size is set to 1476 as the factory default. Packet size can be modified in the GigE Vision Transport Layer Control section of the camera control tool (see below). For AD-130GE, users may enter any value for the packet size and the value will be internally adjusted to an appropriate, legal value that complies with the GenICam standard. Thus, the actual packet size may be different than the value entered by the user.

Caution: do not set the packet size larger than the maximum setting available in the NIC or switch to which the camera is connected. Doing so will cause output to be blocked.

The following table shows possible packet size on each pixel format.

Pixel format	Possible packet size	
8bit	36 + 8 x n	232 ≤ n ≤ 1348
10bit_Packed, 12bit_Packed	36 + 12 x n	174 ≤ n ≤ 1011
10bit,12bit	36 + 16 x n	174 ≤ n ≤ 1011
RGB 8bit	36 + 24 x n	58 ≤ n ≤ 337

- **Note for calculation of Data Transfer Rate**

Setting parameter

Item	Unit	Symbol
Image Width	[pixels]	A
Image Height	[pixels]	B
Bits per Pixel	[bits]	C
Frame Rate	[fps]	D
Packet Size	[Bytes]	E
Number of Packets (including Data Leader & Trailer Packet)	[packets]	G
DataTransfer Rate	[Mbit/s]	J

Fixed value

Item	Unit	value
Data Leader Packet Size	[Bytes]	90
Data Trailer Packet Size	[Bytes]	62

Formula to calculate Data Transfer Rate

J= {90+62+(E+18)*(G-2)} *8*D/1000000

Where, **G=ROUNDUP{A*B*C/8/(E-36)}+2**

The following table shows Bits per Pixel which depends on the pixel format.

Pixel format	Bit
MONO8	8
MONO10	16
MONO10Packed	12
MONO12	16
MONO12Packed	12
BAYRG8	8
BAYRG10	16
BAYRG12	16
RGB8	24
RGB10V1Packed	32
RGB10V2Packed	32

Calculation example: AD-130GE Pixel type Mono8

Item	Unit	Symbol	Setting
Image Width	[pixels]	A	1296
Image Height	[pixels]	B	966
Bits per Pixel	[bits]	C	8
Frame Rate	[fps]	D	31.484
Packet Size	[Bytes]	E	1428
Number of Packets (including Data Leader & Trailer Packet)	[packets]	G	
Transfer Data Rate	[Mbit/s]	J	

G=ROUNDUP{(1296x966x8/8/(1428-36))+2=900+2=902
J={90+62+(1428+18)x(902-2))x8x31.484/1000000=328 Mbit/s

9.3.3 Simplified calculation (Approximate value)

A simple way to calculate the approximate data transfer rate is the following.
Transfer data = image width (pixel) x Image Height (pixel) x depth per pixel (depending on the pixel format) x frame rate / 1,000,000 (convert to mega bit)

In the case of the AD-130GE with the full image and Mono 8bit pixel format;
The data transfer rate = 1296 x 966 x 8 x 31.484 / 1000000 = 315 Mbit/s

9.3.4 Note for 100BASE-TX connection

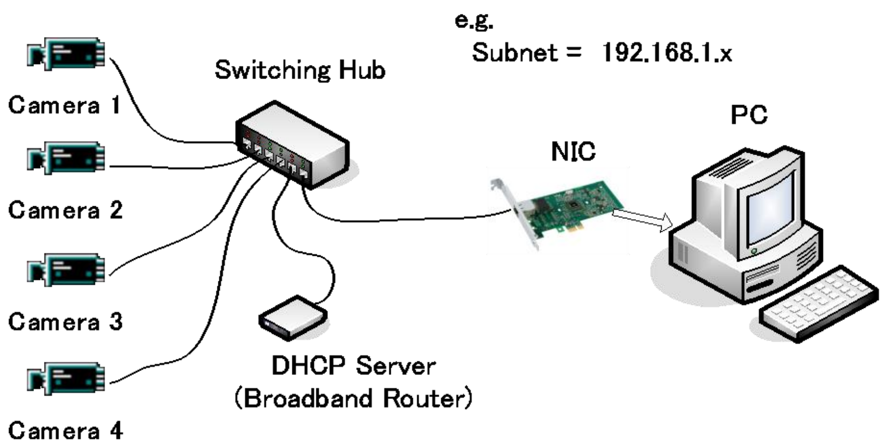
- In order to use 100Mbps network, 100BASE-TX and Full Duplex are available. Half Duplex cannot be used.
- In the case of connecting on 100BASE-TX, the maximum packet size should be 1500 bytes.
- In the case the of connecting on 100BASE-TX, the specifications such as frame rate, trigger interval and so on described in this manual cannot be satisfied.

Pixel Type	Frame rate at Full Frame scan[fps]
MONO8, BAYRG8, BAYGB8	Approx. 7
MONO10_PACKED,MONO12_PACKED	Approx. 5
MONO10, MONO12,BAYRG10, BAYGB10,BAYRG12, BAYGB12	Approx. 3.5
RGB8_Packed	Approx. 2.5
RGB10V1_Packed,RGB10V2_Packed	Approx. 2

Note: The above frame rates are based on approx. 70Mbps of total data.

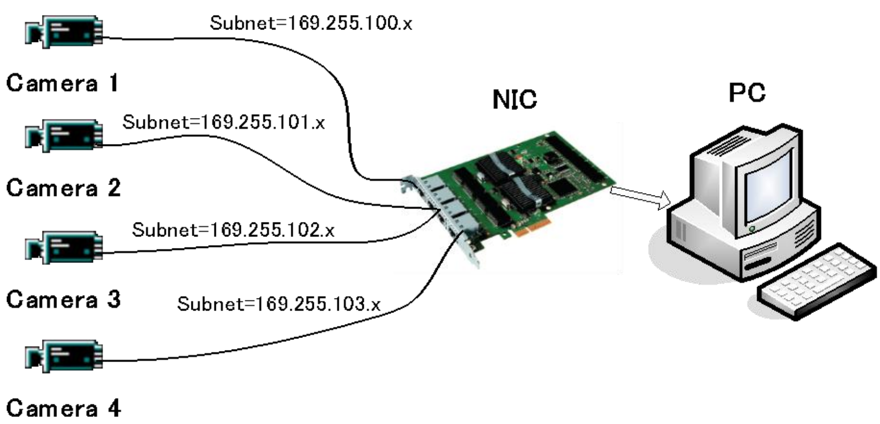
9.4. GigE camera connecting examples

9.4.1 Using a switching hub for 1 port



- All cameras and NIC belong to the same subnet
- The accumulated transfer rate for all cameras should be within 800Mbps
- The packet size and the packet delay should be set appropriately in order for the data not to overflow in the switching hub.

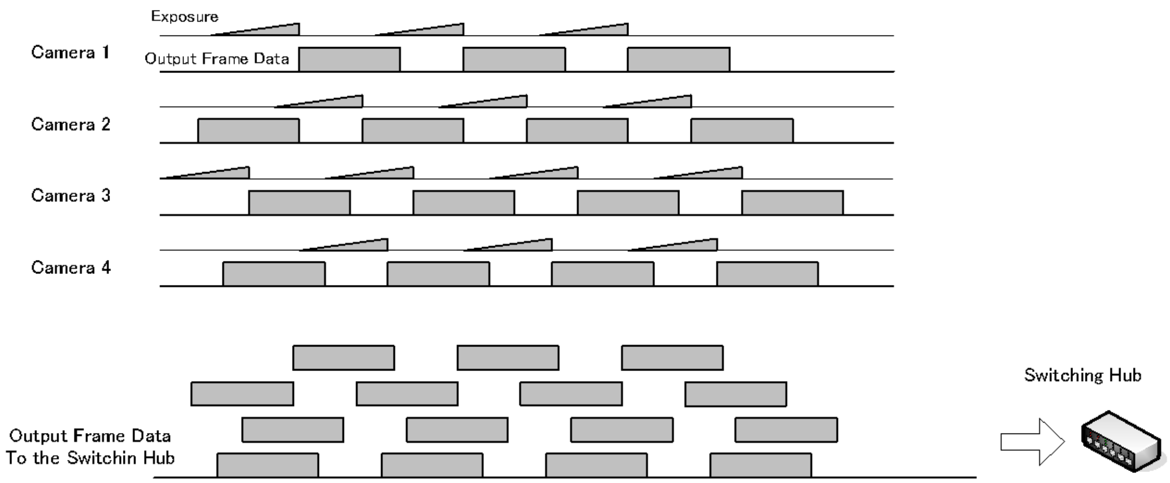
9.4.2 Connecting a camera to each port of a multi-port NIC



- This is the example for using a 4-port NIC
- The pair of the connecting camera and the NIC constructs one subnet. As for the IP configuration, it is appropriate to use the persistent IP.
- In this case, each camera can use the maximum 800Mbps bandwidth. However, the load for the internal bus, CPU and the application software become heavy, so a powerful PC will most likely be required.

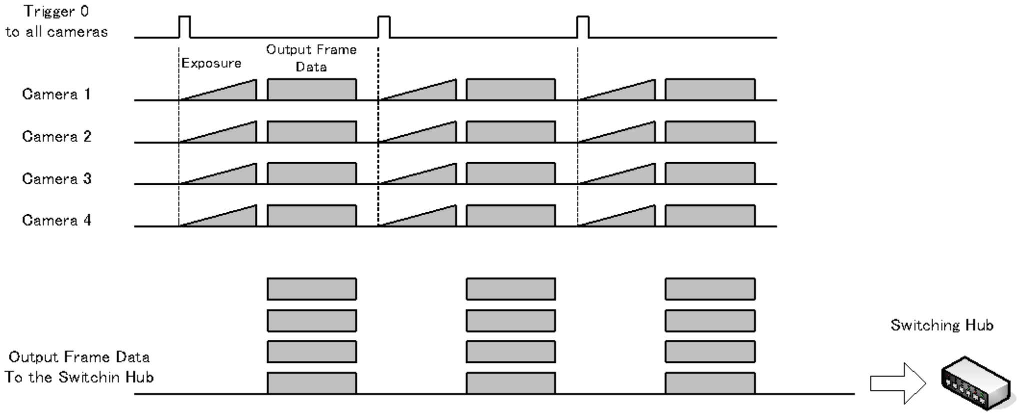
9.4.3 The data transfer for multiple cameras

9.4.3.1 If delayed readout is not used in continuous mode



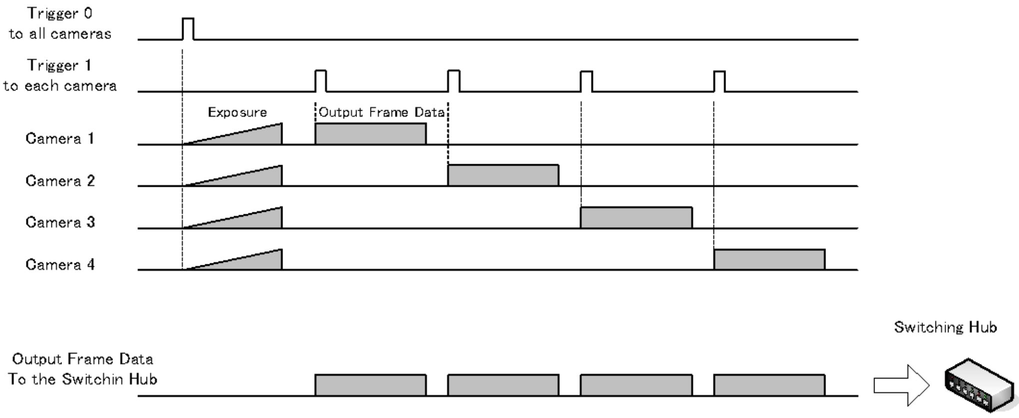
- The packet delay should be set larger. The data traffic is controlled by the buffer of the hub. It is necessary to check the buffer value of the unit.

9.4.3.2 If delayed readout is not used in trigger mode



- The packet delay should be set larger. The data traffic is controlled by the buffer of the hub. It is necessary to check the buffer value of the unit.

9.4.3.3 If delayed readout is used



- The packet delay should be set smaller, and the packet delay trigger controls the data traffic. If the camera has a pulse generator, it can control the data traffic.

10. Functions (Conforming to GenICam SFNC 1.3)

➲ This section describes naming of GenICam SFNC ver.1.3.

AD-130GE uses the feature names specified in GenICam SFNC ver.1.3 but some functions are not implemented. AD-130GE also provides feature names used in previous JAI cameras.

10.1. Acquisition function

Before using trigger and exposure controls, various acquisition controls must be set. The operation of the camera depends on the interrelationship of all three feature sets.

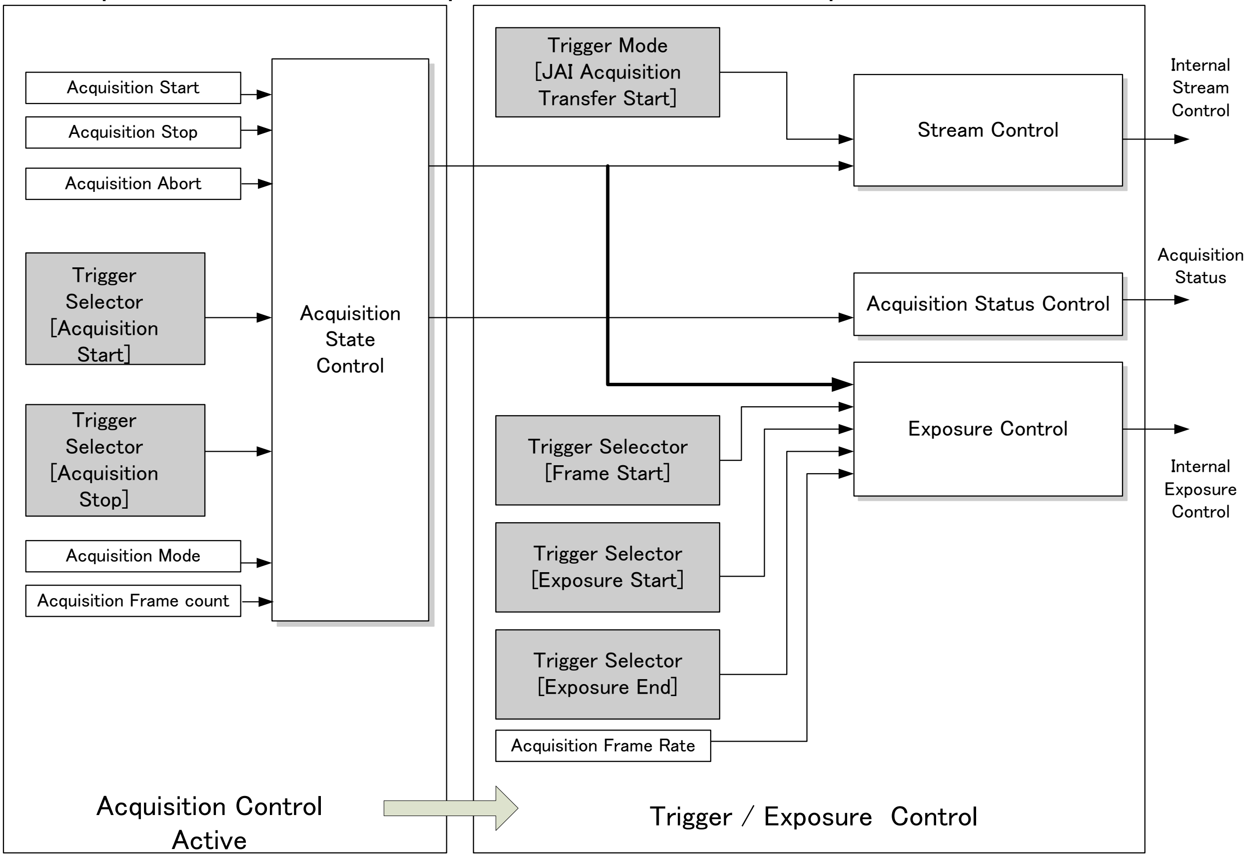


Fig.30 Acquisition control, Trigger/Exposure control work flow

10.1.1 Basic image acquisition flow

The basic commands for acquiring images are as follows:

Acquisition mode — To determine the number of the frame to be captured

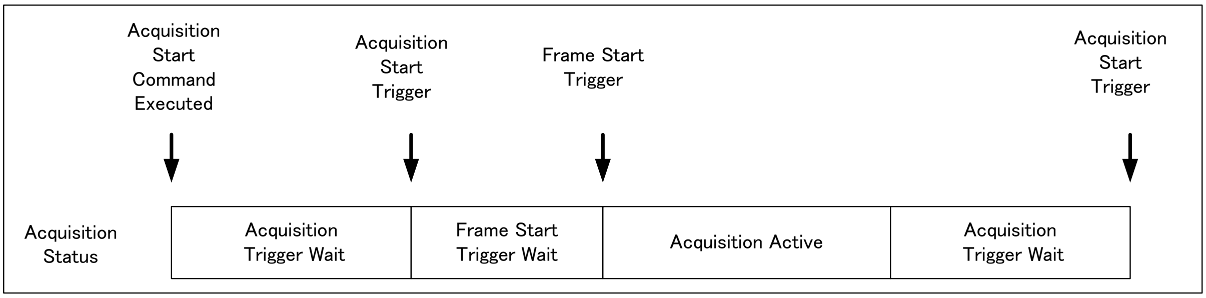
Trigger Selector — Acquisition Start Trigger
Select if the acquisition start is controlled externally
Acquisition End
Select if the acquisition end is controlled externally

Trigger Selector — Frame start
Select if the acquisition of the frame is controlled externally.

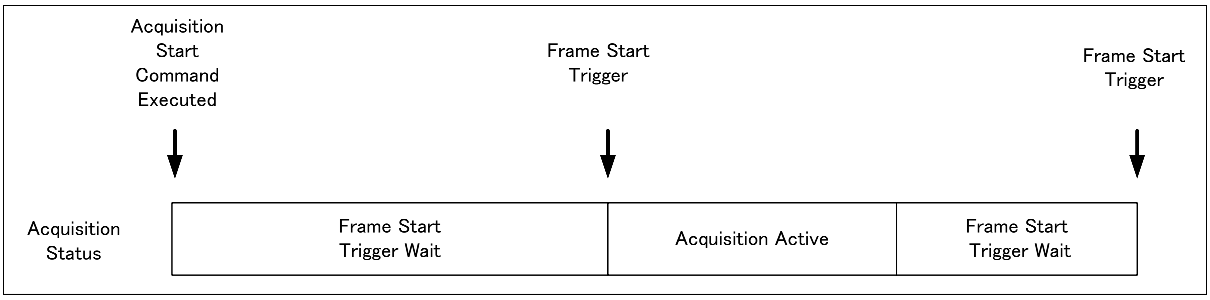
Exposure mode To set the exposure method

The flow of these commands is shown below.
The following drawings are based on the conditions that the Acquisition mode is Single and the Trigger selector is Frame Start.

If the acquisition start is set at ON (The acquisition is controlled externally)



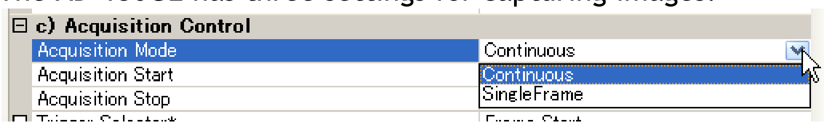
If the acquisition start is set at OFF (The acquisition is controlled internally)



The following sections provide the details for each command set.

10.1.2 Acquisition mode

The AD-130GE has three settings for capturing images.



① Single frame
AcquisitionStart command outputs one frame. Then the acquisition is stopped.
② Continuous
AcquisitionStart command outputs frames until AcquisitionEnd is initiated.

10.1.2.1 Single Frame

In single frame mode, executing the AcquisitionStart command causes one frame to be captured. After one frame is captured, this operation is automatically stopped. In order to restart the capture, it is necessary to input the AcquisitionStart command again. BlockID is not reset until AcquisitionEnd is input and is incremented when the AcquisitionStart command is called.

◆ Normal single frame operation
1) AcquisitionStart command is input
2) AcquisitionActive becomes “TRUE” (accepts capture)

3) 1 frame is output
4) AcquisitionActive becomes “FALSE” (stop capturing)

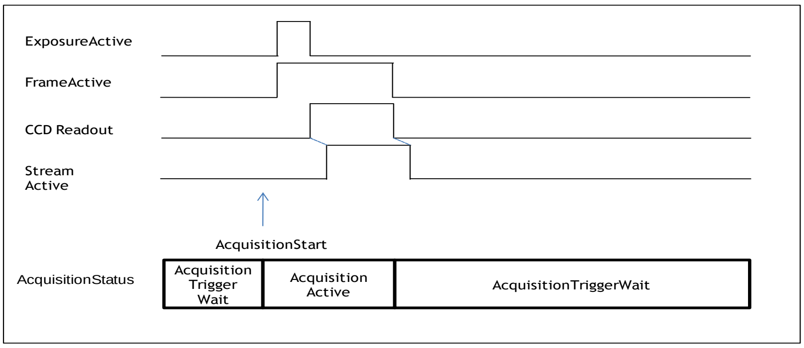


Fig.31 Single frame timing

This drawing shows a case where the trigger is “OFF”. If the trigger is ON, FrameActive becomes “TRUE” on the different timing of AcquisitionActive.

◆ Forcing acquisition to stop
While AcquisitionActive is “TRUE”, if AcquisitionEnd or AcquisitionAbort is initiated, AcquisitionActive becomes “FALSE” (stop capturing).

10.1.2.2 Continuous mode

In this mode, when the AcquisitionStart command is set, the image is continuously output at the current frame rate. This is the default setting for the AD-130GE.

1) AcquisitionStart command is input
2) AcquisitionTriggerWait becomes effective
3) AcquisitionActive becomes “TRUE”
4) Images begin outputting continuously
5) AcquisitionEnd command is sent
6) AcquisitionActive becomes “FALSE”. At this moment, the output stops.

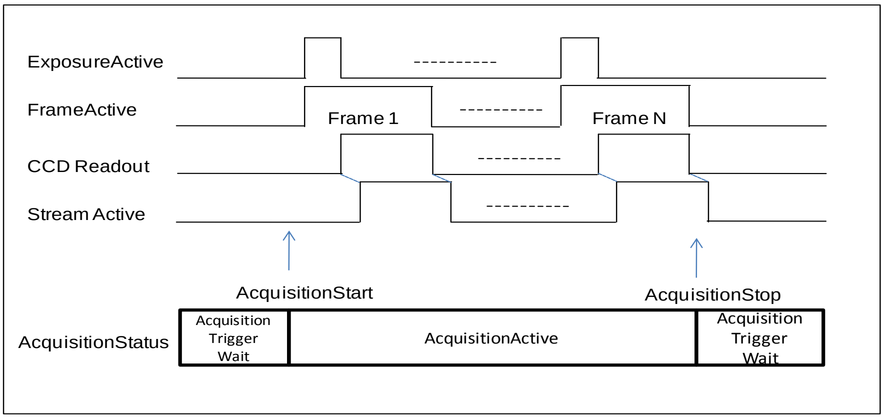


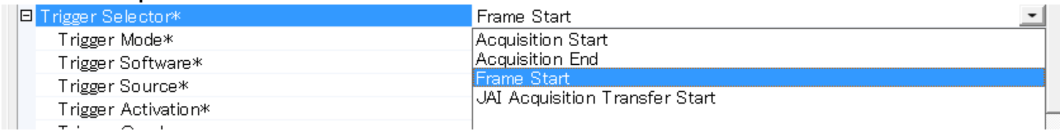
Fig.32 Continuous timing

This drawing shows a case where the trigger is “ON”. If the trigger is OFF, FrameActive becomes “TRUE” at the same timing as AcquisitionActive.

10.2. Trigger Control

10.2.1 TriggerSelector(TriggerMode)

This is the function to set the trigger operation. This will set how to control the output and the exposure.



Frame Start	Trigger	Set the frame start externally
Transfer Start	Stream	Set the stream start externally

10.2.1.1 Acquisition

This is the trigger function to control the output. This controls AcquisitionStart and AcquisitionEnd. A description of the configuration process is as follows:

◆ AcquisitionStart trigger: Set whether the capture start is to be controlled externally or not.

TriggerMode On: After AcquisitionStart command is input, input the signal selected by AcquisitionStart trigger as the trigger, and make AcquisitionActive effective.

TriggerMode Off: AcquisitionStart command is input. It makes AcquisitionActive effective regardless of AcquisitionStart trigger.

◆ AcquisitionEnd trigger: Set whether the end of the capture is to be controlled externally or not.

TriggerMode On: While AcquisitionActive is effective, input the signal selected by AcquisitionEnd as the trigger, and make AcquisitionActive invalid.

TriggerMode Off: AcquisitionStart command is input. It makes AcquisitionActive invalid regardless of the trigger source.

10.2.1.2 Exposure

These commands are used for setting the exposure control.
FrameStart is used for trigger input.
If ExposureMode is set to Timed or TriggerWidth except OFF, the combination of the ExposureMode setting and FrameStart setting will determine the type of exposure and whether triggering is OFF or ON.
The following table shows the combination and the operation.

TriggerSelector / ExposureMode	Frame Start	Operation	Previous JAI trigger name (for reference)
OFF	OFF or ON	Trig OFF(Free run) No Exposure Control	Trigger OFF
Timed	OFF	Trig OFF(Free run) Exposure Control Is possible	Trigger OFF
	ON	Trig On	EPS
TriggerWidth	OFF	Trig OFF(Free run) No Exposure Control	Trigger OFF
	ON	Trig On	PWC

- FrameStart trigger: Set whether the start of the frame is to be controlled externally or not.

  TriggerMode On: While AcquisitionActive is effective and ExposureMode is set at Timed or TriggerWidth, start exposure using the signal selected by FrameStart trigger.

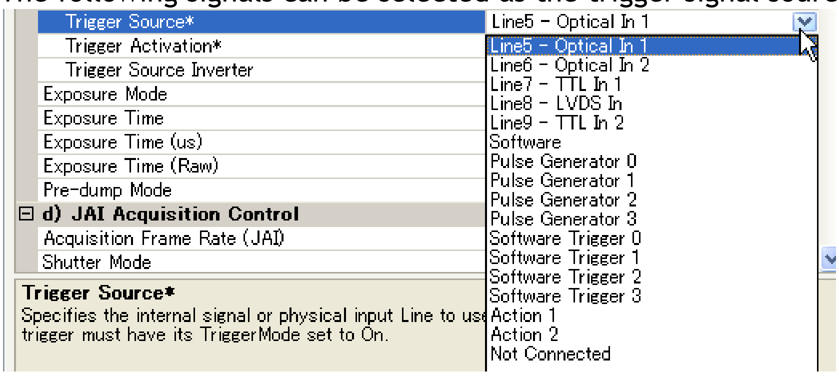
  TriggerMode Off: While AcquisitionActive is effective, self-running operation takes place.

10.2.2 Triggersoftware

This is one of the trigger sources and is the software trigger command.
This has one command signal to each of the 6 items of TriggerSelector.
To use this function, TriggerSource must be set at TriggerSoftware.

10.2.3 Triggersource

The following signals can be selected as the trigger signal source.



10.2.4 TriggerActivation

This determines the behaviour of the trigger.

RisingEdge:	Initiate at the signal rising edge
FallingEdge:	Initiate at the signal falling edge
LevelHigh:	Initiate during the signal high level
LevelLow:	Initiate during the signal low level

Note: When TriggerWidth is used, TriggerActivation should be set at either LevelHigh or LevelLow.

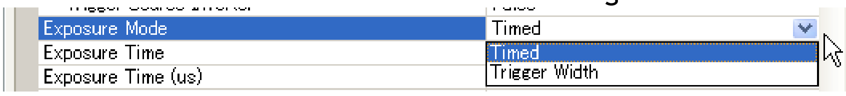
	RisingEdge	FallingEdge	LevelHigh	LevelLow
Timed	O	O	×	×
TrigegrWidth	×	×	O	O
Timed-JAI Pre-Dump	O	O	×	×

10.3. Exposure Control

This is the function to manage the exposure settings.

10.3.1 Exposure Mode

The exposure mode can be selected from the following choices.



Timed: The exposure time is to be set in microseconds.
If FrameStart in TriggerSelector is "OFF", the exposure is controlled in Free Run.
If FrameStart in TriggerSelector is "ON", this functions as the EPS mode.

Note: JAI Pre-Dump can be available by using TriggerOption.

TriggerWidth: This mode controls the exposure time by the pulse width.
If FrameStart in TriggerSelector is "OFF",
The camera operates in Free Run.
If FrameStart in the TriggerSelector is "ON", this functions as the PWC mode.

The following is the table for the combination of ExposureMode and TriggerControl and its function.

TriggerSelector / ExposureMode	Frame Start	Operation	Previous JAI trigger name (for reference)
OFF	OFF or ON	Trig OFF(Free run) Exposure controllable	Trigger OFF
Timed	OFF	Trig OFF(Free run) Exposure control is possible	Trigger OFF
	ON	Trig On	EPS
TriggerWidth	OFF	Trig OFF(Free run) No Exposure control	Trigger OFF
	ON	Trig On	PWC

10.3.2 ExposureTime

This is effective only if ExposureMode is set to"Timed".
This command can set the exposure time.
The setting can be done in 1μs / step.
Minimum: 11.49μs
Maximum: 31.76msec

10.3.3 ExposureAuto

This is auto exposure control function and is effective only in the "Timed"mode.
The reference video level is controlled by JAI AGC Reference.
ExposureAuto includes OFF, Once and Continuous modes.
The following detailed settings are aslo possible.

ExposureAuto speed:	The reaction speed can be controlled
ExposureAuto Max:	Set the maximum exposure time
ExposureAuto Min:	Set the minimum exposure time
GainAutoReference:	Set the reference video level for operation

10.4. ActionControl

ActionControl is used to activate the specific functions of multiple cameras on the same network at the same time. For instance, it can be used to trigger multiple cameras at the same time.

ActionControl appears as two inputs (Action 1, Action 2) and is connected with 6 Triggers, CounterReset of the counter, CounterTrigger and Timer.
If ActionControl is used, the input source to the trigger should be set to Action 1 or Action 2 in advance.

10.4.1 ActionDeviceKey

Set the same value to cameras which are operated at the same time.

10.4.2 ActionSelector

Select Action 1 or Action 2.

10.4.3 ActionGroupMask

Set the mask value for grouping Action 1 operation.

10.4.4 ActionGroupKey

Set the key (value) to operate Action 1.

10.5. Operation Mode

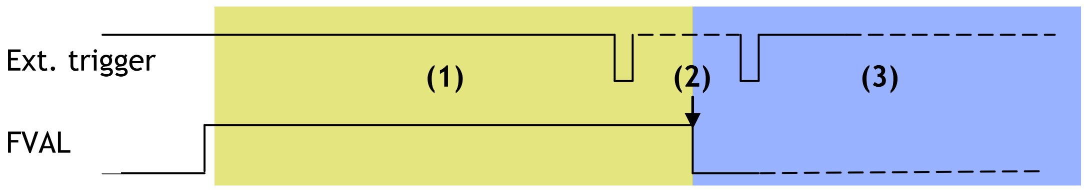
AD-130GE has the setting for the exposure timing when the trigger pulse is applied and the following 9 operation modes and OB transfer and ROI modes.

1	*Trigger mode*	*Continuous mode*
2	*Trigger mode*	*Edge Pre-Select Trigger*
3	*Trigger mode*	*Pulse Width Control Trigger*
4	*Trigger mode*	*Reset Continuous Trigger*
5	*Trigger mode*	*Sequence EPS*
6	*Trigger mode*	*Delayed readout EPS*
7		*Smearless*
8		*OB transfer mode*
9		*ROI mode*

10.5.1 The exposure timing when the trigger pulse is input

10.5.1.1 Auto-detect LVAL-sync / async accumulation

This function replaces the manual setting found in older JAI cameras. Whether accumulation is synchronous or asynchronous in relationship to LVAL depends on the timing of the trigger input. When a trigger is received while FVAL is high (during readout), the camera works in LVAL-synchronous mode, preventing reset feed-through in the video signal. There is a maximum jitter of one LVAL period from issuing a trigger to accumulation start.
When an external trigger is received during FVAL low, the camera works in LVAL-asynchronous (no delay) mode.
This applies to both Pre-Select (PS) trigger and Pulse Width trigger (PW) modes.



(1) In this period camera executes trigger at next LVAL (prevents feed-through noise)
(2) Avoid trigger at FVAL transition (+/- 1 LVAL period), as the function may randomly switch between "next LVAL" and "immediate".
(3) In this period camera executes trigger immediately (no delay)

Fig. 33 Auto-detect LVAL sync /a-sync accumulation

10.5.1.2 Relation between the external trigger mode and LVAL Sync/Async

Operation : Exposure Mode (JAI)	Smearless Enable	LVAL SYNC	LVAL ASYNC
Edge pre-select	False	○	○
	True	×	○
Pulse-width control	False	×	○
	True	×	○
RCT Mode	-	×	○
Sequential EPS trigger	False	× (note1)	○
	True	×	○
Delayed readout EPS trigger	False	○	○
	True	×	○
Delayed readout PWC trigger	False	×	○
	True	×	○

Note 1: In the sequence trigger mode, each entry in the sequence can be set to its own exposure time and gain. Therefore, the LVAL sync operation does not function. Please arrange for the trigger input timing to occur during FVAL LOW (LVAL Async).

10.5.2 Continuous mode

For applications not requiring asynchronous external triggering, this mode should be used for continuous operation.

To use this mode

Set function:	Acquisition mode	:Continuous
	Trigger mode	:OFF
	Sync mode	:Sync / Async
	Exposure Mode	:Timed
	Pixel Format	:8bit、10bit、12bit
	Other functions	

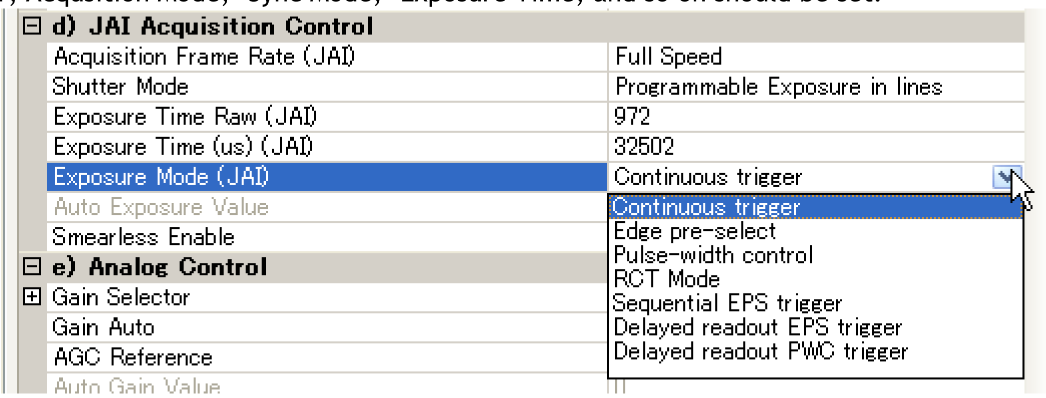
10.5.3 Edge Pre-Select (EPS) trigger mode

An external trigger pulse initiates the capture, and the exposure time (accumulation time) is the fixed shutter speed set by registers. The accumulation can be LVAL synchronous or LVAL asynchronous. The resulting video signal will start to be read out after the selected shutter time.

To use this mode:

Set function:	Acquisition mode	:Frame Start
	Trigger mode	:ON
	Sync mode	:Sync / Async
	Exposure Mode	:Timed
	Exposure time	:Exposure time/Exposure time(us)/ Exposure time(Raw)
	Other functions	
Input:	External Trigger	Trigger Source

This function can be set by selecting Edge pre-select in Exposure mode of JAI Acquisition Control. However, Acqusition Mode, Sync Mode, Exposure Time, and so on should be set.



Important Note:

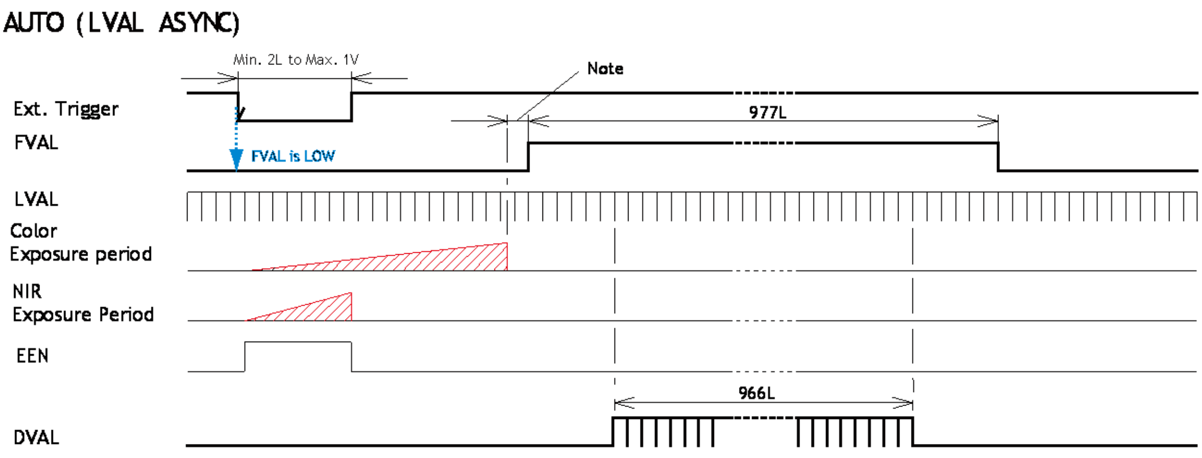
The trigger minimum active period is 2L and the minimum interval of the trigger is shown below.

SYNC Mode	Smearless Enable	Minimum trigger interval (Line)	
SYNC Mode= SYNC	False	LVAL ASYNC	Frame interval in continuous operation + Larger Exposure Time(Raw) between Color and IR+ 5L
		LVAL SYNC	① If Exposure Time(Raw) range is 3L to (Frame interval in continuous operation(L) - 1L) Frame interval in continuous operation + Difference between Color and IR + 5L
			② If JAI Partial Scan is set at True and Exposure Time(Raw) range is Frame interval in continuous operation(L) to 982L Frame interval in continuous operation(L) +(Difference between Color and IR exposure time)+ 5L + (Smaller exposure time between color and IR - Frame interval in continuous operation(L) + 1L)
	True	LVAL ASYNC	Smear less period[196L]+ 1 + (Larger exposure time between color and IR)+ Frame interval in continuous operation(L) + 6L
SYNC Mode= ASYNC	False	LVAL ASYNC	Frame interval in continuous operation(L) + Exposure Time(Raw) + 5L
		LVAL SYNC	① If Exposure Time(Raw) range is 3L to (Frame interval in continuous operation(L) - 1L) Frame interval in continuous operation(L) + 5L
			② If JAI Partial Scan is set to True and Exposure Time(Raw) range is Frame interval in continuous operation (L) to 982 Frame interval in continuous operation(L) + Exposure Time(Raw) – Frame interval in continuous operation(L) + 6L
	True	LVAL ASYNC	Smearless period[196L]+ 1 +Exposure Time(Raw)+ Frame interval in continuous operation (L)+ 6L

1) LVAL SYNC/ASYNC can be selected automatically.
2) Frame interval of full frame in continuous operation is 982L and if JAI partial scan is set to True, please refer to 8.4.3 Partial Scan Vertical Timing for the frame interval.
3) If Smearless Enable is set to True, only LVAL Async is available.

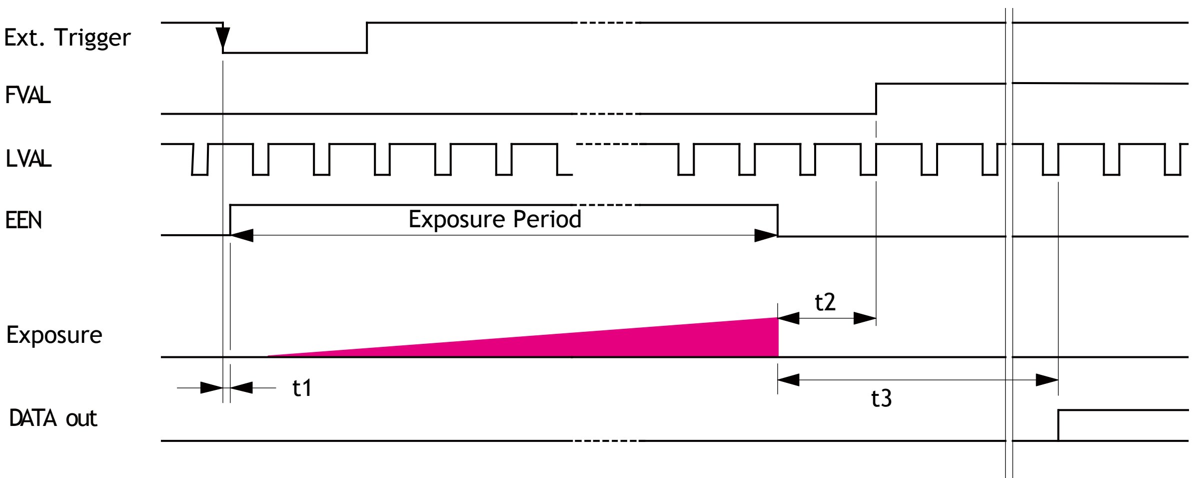
10.5.3.1 Timing chart

Following charts are examples if Sync mode is set to Sync and in full frame operation.
If Sync mode is set to Sync, the timing of trigger input is the same for both camera #0 and #1. The exposure time can be set individually but the output timing of the video output is the same.



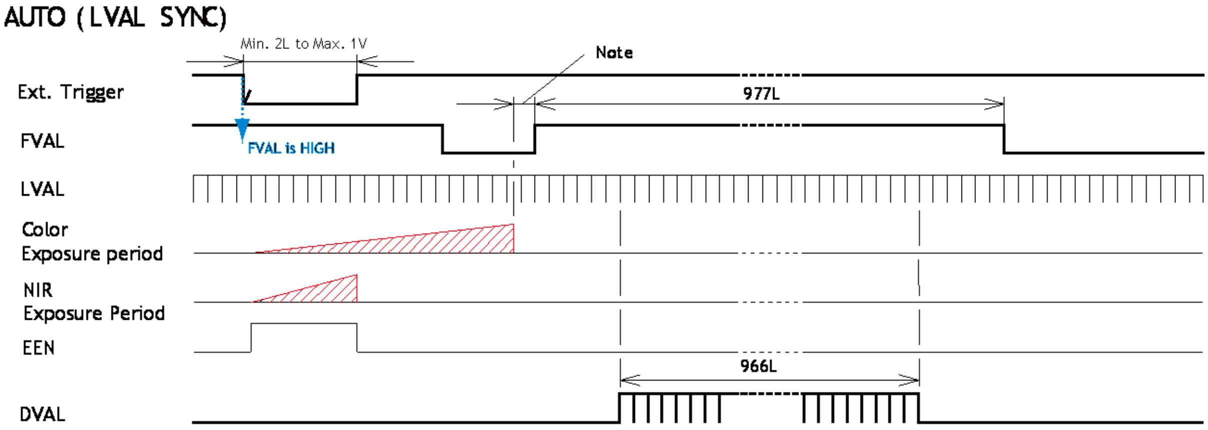
Note: 2.8L to 3.8L after the exposure end of the longest exposure.
1 LVAL = 1660 clock (32.344µs)

Fig.34 Edge Pre-select LVAL asynchronous



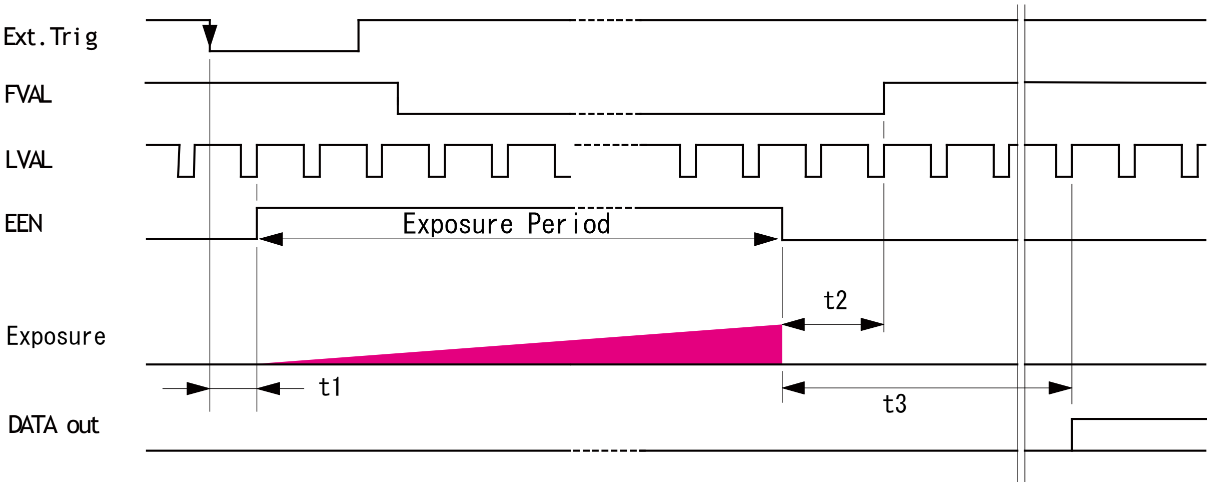
t1(Exposure start delay)	t2	t3(Data output delay)
6.03µs	2.8L to 3.8L	10.8L to 11.8L

Fig.35 Edge Pre-select LVAL asynchronous details



Note: 2.8L after the exposure end of the longest exposure

Fig.36 Edge Pre-select LVAL synchronous



t1(Exposure start delay)	t2	t3(Data output delay)
0.1L ～ 1.1L(3 ～ 35.2μs)	2.8L	10.8L

Fig.37 Edge Pre-select LVAL synchronous details

Note for setting Exposure Time
For instance, if the exposure time for the color channel is 1/31 sec and that of the monochrome IR channel is 1/87,000 sec, the picture quality of the monochrome IR channel may not be acceptable due to CCD's operational principle. Accordingly, in EPS mode, each channel's exposure time should be set the same. If it is necessary to set different exposure times, please confirm the picture quality in advance of usage.

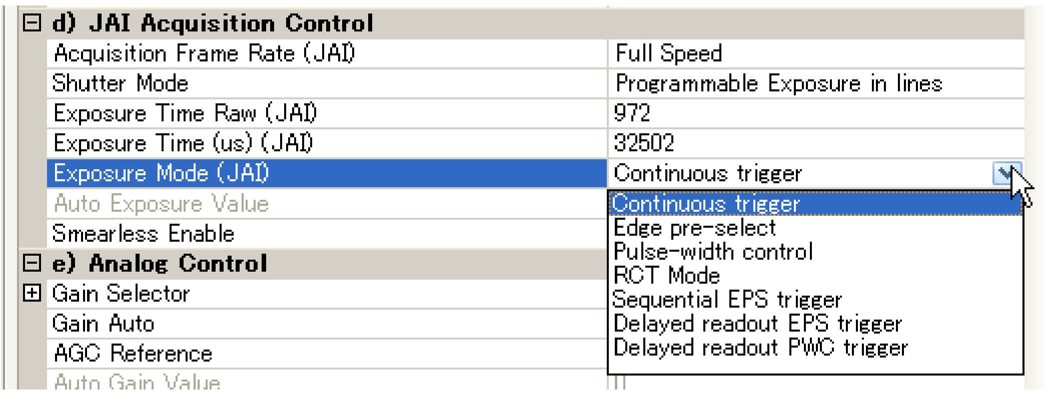
10.5.4 Pulse Width Control (PWC) trigger mode

In this mode the accumulation time is equal to the trigger pulse width. Here it is possible to have a long time exposure. The maximum recommended time is <60 frames.
In PWC mode, only LVAL asynchronous accumulation is effective.

To use this mode:

Set function:	Acqusition mode	:Frame Start
	Trigger mode	:ON
	Sync mode	:Sync / Async
	Exposure Mode	:Trigger Width
	Exposure time	:Exposure time/Exposure time(us)/ Exposure time(Raw)
	Other functions	
Input:	External Trigger	Trigger Source

This function can be set by selecting Pulse width control in Exposure mode of JAI Acquisition Control. However, Acquisition Mode, Sync Mode, Exposure Time, and so on should be set.



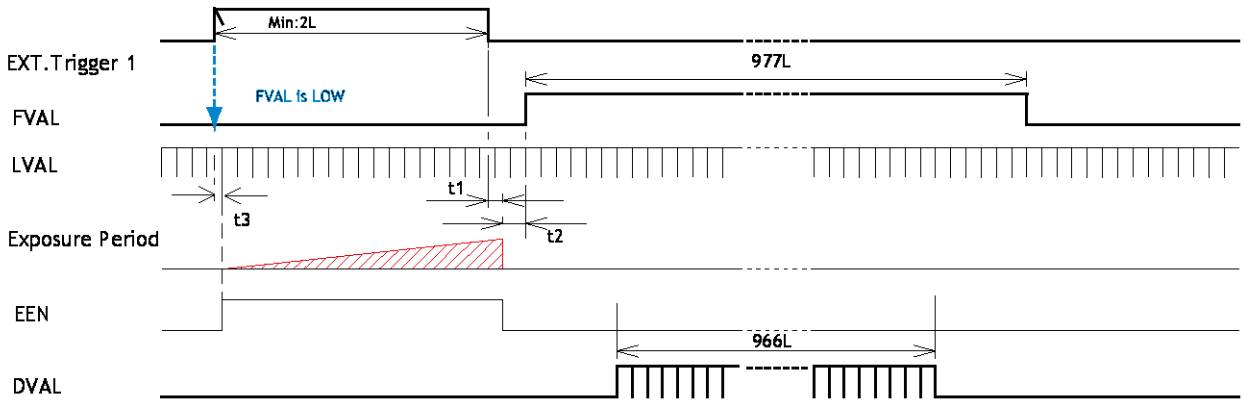
Important Note:
The minimum duration of the trigger is 2L. The minimum period of trigger is as follows.

SYNC Mode	Smearless Enable	Minimum Trigger interval (Line)	
SYNC Mode =SYNC	False	LVAL ASYNC	(Trigger Pulse width: Min.2L) + Frame interval in continuous operation(L) + 4L
	True	LVAL ASYNC	(Trigger Pulse width:Min.197L+2L) + Frame interval in continuous operation(L) + 4L
SYNC Mode =ASYNC	False	LVAL ASYNC	(Trigger Pulse width: Min.2L) + Frame interval in continuous operation (L) + 4L
	True	LVAL ASYNC	(Trigger Pulse width : Min.197L+2L) + Frame interval in continuous operation(L) + 4L
Pulse-width trigger is available only in LVAL Async accumulation.			

10.5.4.1 Timing chart

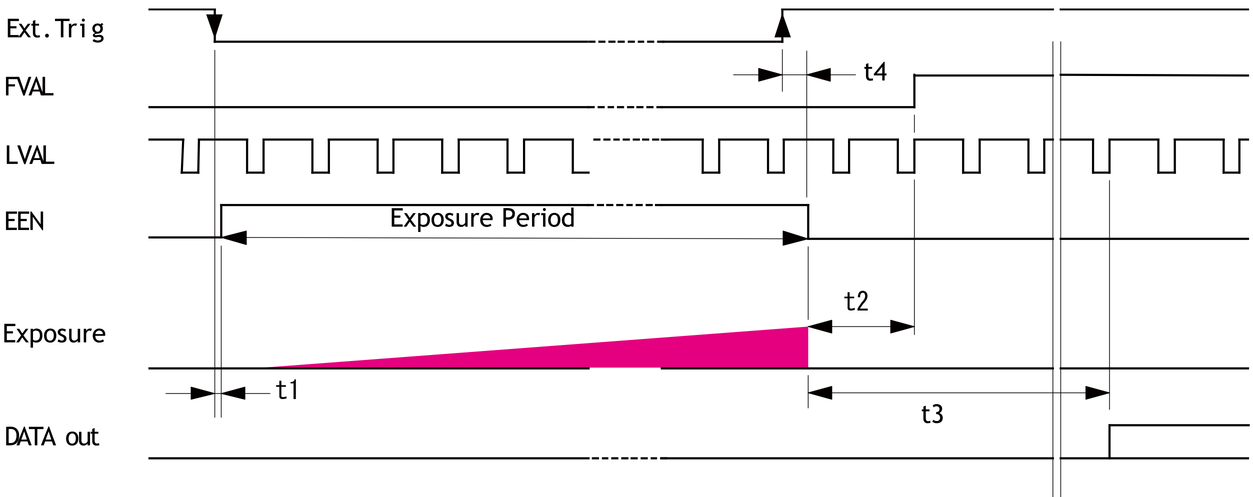
Following charts are the timing if Sync mode is set to Sync.
In this case, the trigger input is the same for both camera#0 and #1 and the output timing is the same.

(LVAL ASYNC)



t1	t2	t3
0.5L	2.8L ～ 3.8L	0.2L

Fig.38 Pulse Width Control LVAL asynchronous



t1(Exposure start delay)	t2	t3(Output delay)	t4(Exposure end delay)
6.03μs	2.8L ～ 3.8L	10.8L ～ 11.8L	17.45μs

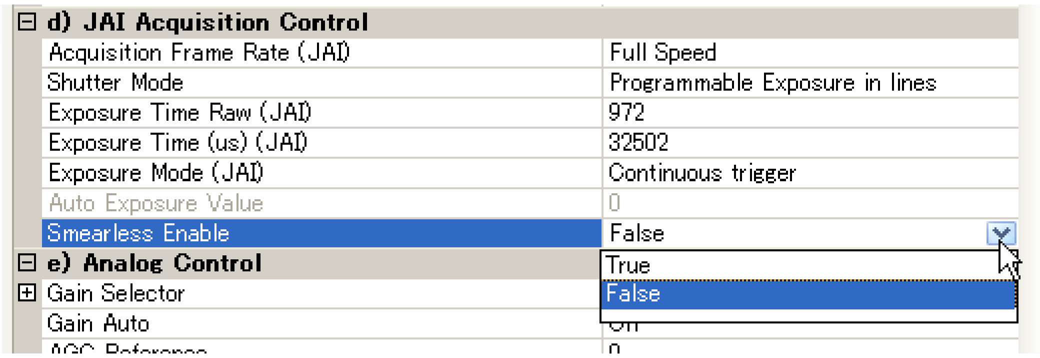
Fig.39 Pulse Width Control LVAL asynchronous details

In PWC mode, when “Smearless ON ” is selected, the actual accumulation time is the trigger pulse width minus Smearless active period (197L+2L).
If the trigger pulse width is shorter than 199L, the exposure is not active.

10.5.5 Smearless mode

This function can be used to reduce the smear coming from bright areas or objects within the image. This is effective for both EPS and PWC trigger modes. Before the accumulation starts, any charge that is stored in the pixel is dumped by a high-speed transfer. This can reduce the smear that is visible directly above a bright object in the image, but the smear showing below the object is unaffected.
At the falling edge of the trigger pulse the high speed transfer starts. This period is 6.34ms which is 196L. Thereafter the residual charge in the horizontal CCD register is read out in 1L and the new exposure starts. This function is available for both full scan and partial scan.

This function can be set if Smearless Enable in JAI Acquisition Control is set at True.



d) JAI Acquisition Control	
Acquisition Frame Rate (JAI)	Full Speed
Shutter Mode	Programmable Exposure in lines
Exposure Time Raw (JAI)	972
Exposure Time (us) (JAI)	32502
Exposure Mode (JAI)	Continuous trigger
Auto Exposure Value	0
Smearless Enable	False
e) Analog Control	True
Gain Selector	False
Gain Auto	

10.5.5.1 Sync=Sync, LVAL Async, Smearless Enable=True, EPS trigger

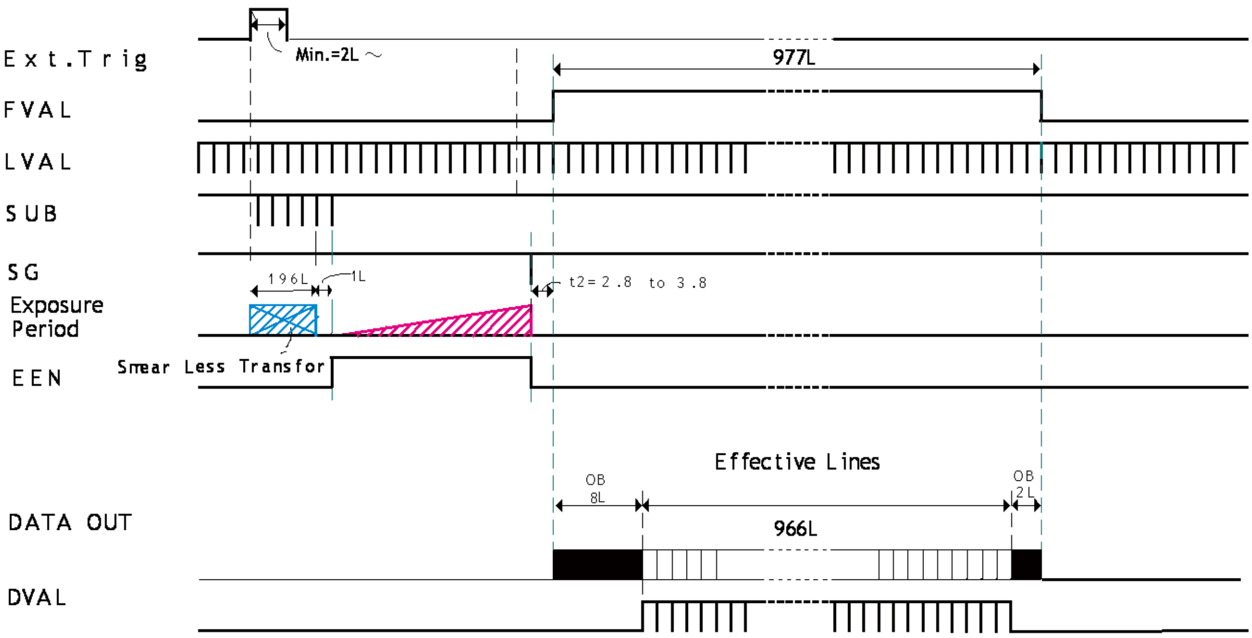


Fig. 40 Smearless, EPS trigger timing chart

10.5.5.2 Sync Mode=Sync, LVAL Async, Smearless Enable=True, PWC trigger

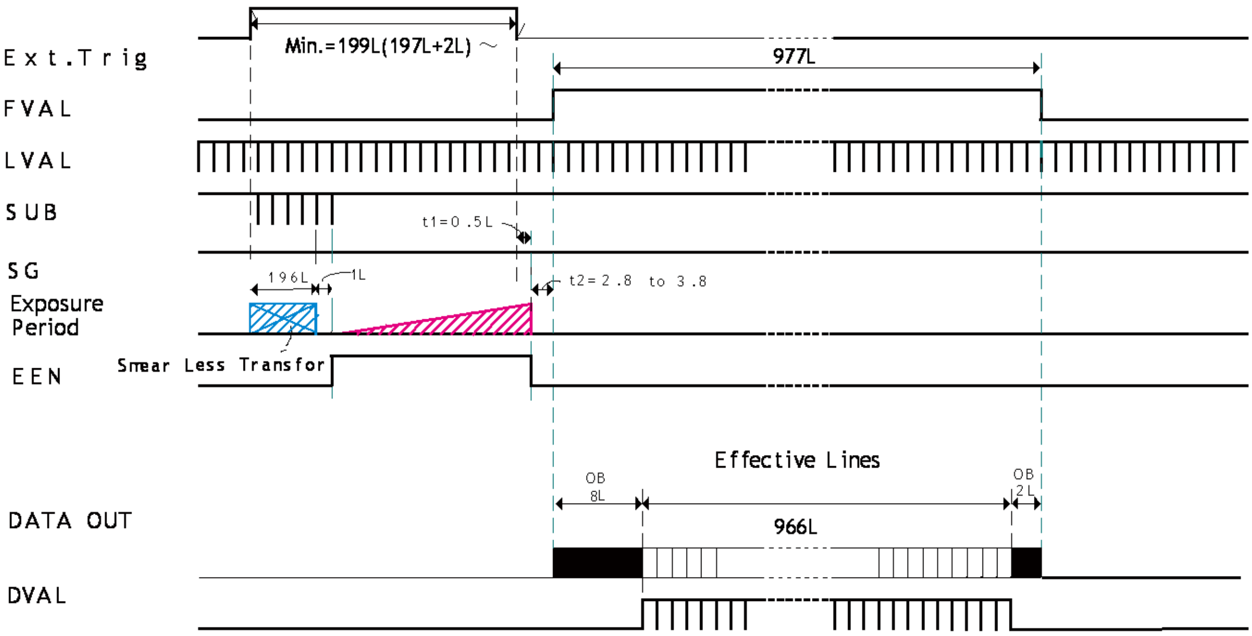


Fig 41. PWC timing chart with Smearless ON

10.5.6 Reset Continuous Trigger (RCT) mode

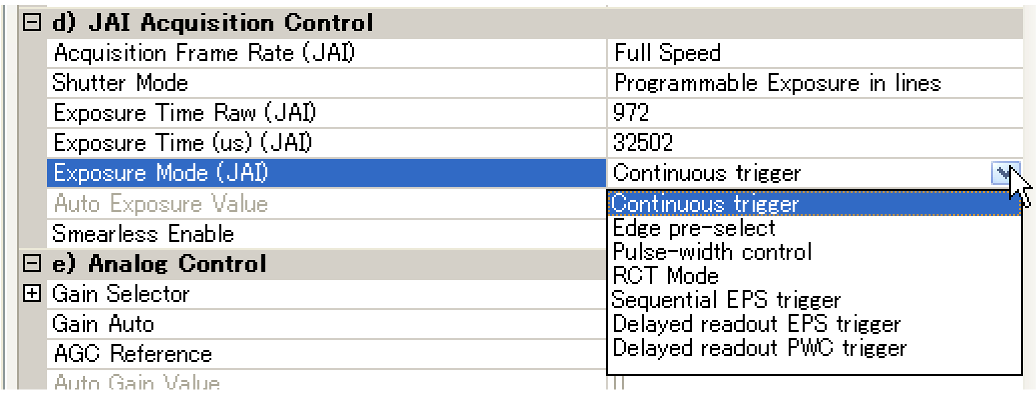
The RCT mode operates like EPS (edge pre-select) mode with smearless function. An external trigger pulse will immediately stop the video read out, reset and restart the exposure, then operate as normal mode until the next trigger. After the trigger pulse is input, a fast dump readout is performed. In the AD-130GE, this period is 6.34ms which is 196L. The exposure time is determined by the pre-set shutter speed. If no further trigger pulses are applied, the camera will continue in normal mode and the video signal is not output. The fast dump readout has the same effect as "smearless readout". Smear appearing above highlight areas is reduced for the trigger frame. The Reset Continuous Trigger mode makes it possible to use triggering in conjunction with a lens with video controlled iris.

To use this mode:

Set function:	Acqusition mode	:Frame Start
	Trigger mode	:ON
	Sync mode	:Sync / Async
	Exposure Mode	:Timed
	Exposure time	:Exposure time/Exposure time(us)/ Exposure time(Raw)
	Pre-dump mode	:ON
	Other functions	
Input:	External Trigger	Trigger Source



This function can be set by selecting RCT mode in Exposure mode of JAI Acquisition Control. However, Acqusition Mode, Sync Mode, Exposure Time, and so on should be set.



Important notes on using this mode

- The minimum duration of the trigger is 2 LVAL. The minimum period of the trigger input is the following.

Sync mode: Async	Smearless period(196L)+1+ Exposure Time(RAW) + Frame interval in continuous operation(L) + 6L
Note: If the next trigger is input during the output of transfer signal, this output signal is immediately stopped and thrown away by the High Speed Transfer operation.	

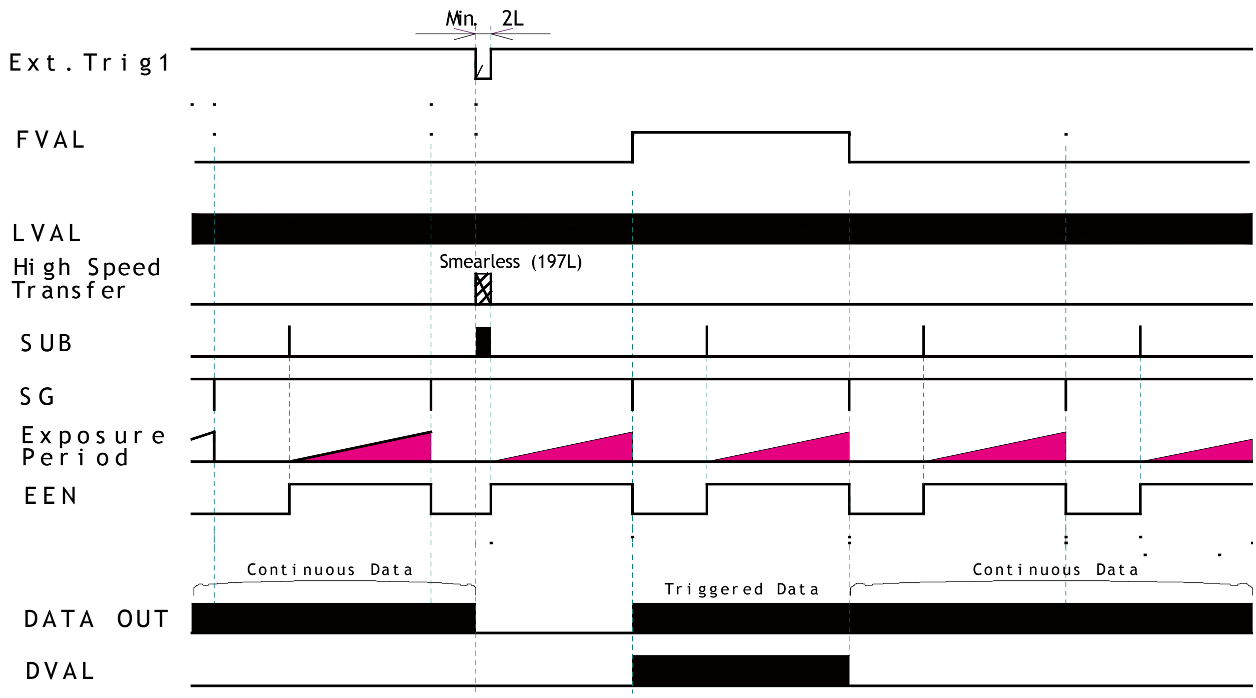


Fig.42 Reset Continuous Trigger

10.5.7 Sequential Trigger Mode (EPS)

This mode allows the user to define a preset sequence of up to 10 images, each with its own ROI, Shutter and Gain values. As each trigger input is received, the image data with the preset sequence is output as described below.

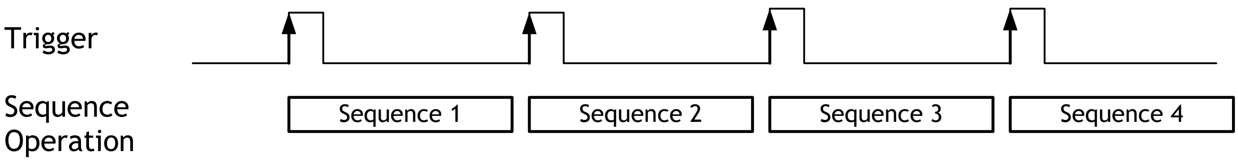


Fig.43 Sequential Trigger Mode

10.5.7.1 Setting parameters

Following parameters in Sequence control should be adjusted.

(1) Sequence Mode:
Sequence Mode = On is to set to Sequential EPS Trigger mode.

(2) Sequence Repetition Count: (applicable value: 0～255)
This sets how many times the sequence is repeated.
If the last Sequence Repetition Count is completed, the sequence table is set tothe Last Sequence setting. If further trigger pulses are input, the settings for the Last Sequence, are repeated until Reset Sequence is input.
Sequence Repetition Count = 0 will cause the sequence to repeat indefinitely.

(3) Last Sequence：(applicable value：1～10)
To determine how many sequences out of sequences 1 to 10 are executed as one consecutive sequence.

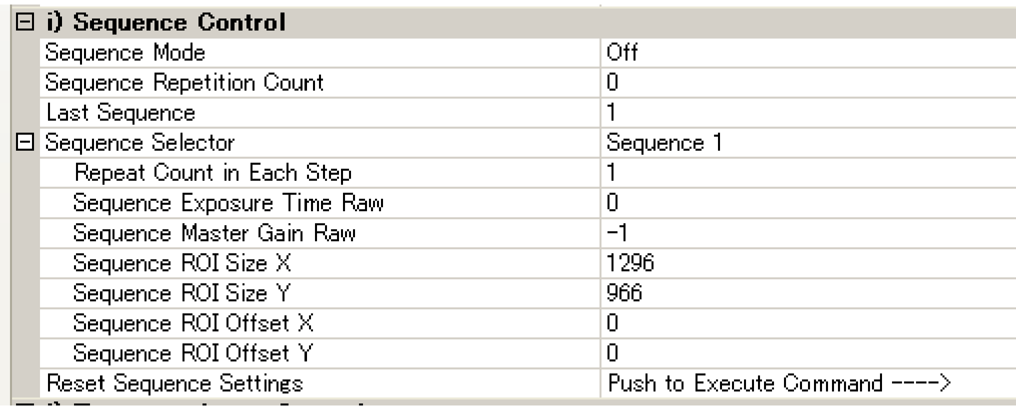
(4) Sequence Selector：
In the Sequence Selector, there are 10 sequence tables.
Each Sequence has 8 setting parameters such as Sequence ROI Size X and Y、Sequence ROI Offset X and Y、Sequence Exposure Raw、Sequence Master Gain Raw、and Repeat Count in Each Step.
In the Sequential EPS Trigger, the order to execute is from Sequence 1 settings.

(5) Repeat Count in Each Step：(applicable value：1～255)
After the Sequence table is repeated as many as numbers set in "Repeat Count in Each Step", the next sequence table is activated.

(6) Reset Sequence command：
If the Reset Sequence is applied during sequence operation, the sequence operation is initialized to start at sequence 1.

(7) Sequence Table Reset input:
The Sequence Table Reset is available from GPIO output port.
This initializes the sequence operation by hardware trigger.

The following is how the settings appear in the GUI.



i) Sequence Control	
Sequence Mode	Off
Sequence Repetition Count	0
Last Sequence	1
Sequence Selector	Sequence 1
Repeat Count in Each Step	1
Sequence Exposure Time Raw	0
Sequence Master Gain Raw	-1
Sequence ROI Size X	1296
Sequence ROI Size Y	966
Sequence ROI Offset X	0
Sequence ROI Offset Y	0
Reset Sequence Settings	Push to Execute Command ---->

10.5.7.2 Initial settings

The following are the default settings.

Camera 0	Sequence Control						
Sequence Mode	Off						
Sequence Repetition Count	0						
Last Sequence	1						
Sequence Selector	Sequence						Repeat Count in Each Step
	ROI				Exposure Time Raw	Master Gain Raw	
	Size		Offset				
	X	Y	X	Y			
Sequence 1	1296	966	0	0	982	0	1
Sequence 2	1296	966	0	0	982	0	1
Sequence 3	1296	966	0	0	982	0	1
Sequence 4	1296	966	0	0	982	0	1
Sequence 5	1296	966	0	0	982	0	1
Sequence 6	1296	966	0	0	982	0	1
Sequence 7	1296	966	0	0	982	0	1
Sequence 8	1296	966	0	0	982	0	1
Sequence 9	1296	966	0	0	982	0	1
Sequence 10	1296	966	0	0	982	0	1

Camera 1	Sequence Control						
Sequence Mode	Off						
Sequence Repetition Count	0						
Last Sequence	1						
Sequence Selector	Sequence						Repeat Count in Each Step
	ROI				Exposure Time Raw	Master Gain Raw	
	Size		Offset				
	X	Y	X	Y			
Sequence 1	1296	966	0	0	982	0	1
Sequence 2	1296	966	0	0	982	0	1
Sequence 3	1296	966	0	0	982	0	1
Sequence 4	1296	966	0	0	982	0	1
Sequence 5	1296	966	0	0	982	0	1
Sequence 6	1296	966	0	0	982	0	1
Sequence 7	1296	966	0	0	982	0	1
Sequence 8	1296	966	0	0	982	0	1
Sequence 9	1296	966	0	0	982	0	1
Sequence 10	1296	966	0	0	982	0	1

Caution:

1. In the Sequential EPS Trigger, LVAL sync operation is not available as the different exposure time and gain in each sequence table can be set. The trigger should be applied in LVAL Async timing.
2. In order to change values in the Sequence Table are changed, image capture must be stopped.

10.5.8 Delayed Readout EPS and PWC Modes

This mode can be used to delay the transmission of a captured image. When several cameras are triggered simultaneously and connected to the same GigE interface, it allows the cameras to be read out in sequence, preventing congestion.

The image data is not transmitted directly by the Frame Start Trigger and is stored in the memory located at the Ethernet Interface. By the leading edge of the Transfer Start Trigger,

the image data is output.
AD-130GE has up to 6 memories to store, and the stored image data can be output at the consecutive timing of Transfer Start Trigger.
After the stored image is transmitted by Transfer Start Trigger, as the memory has the space, it is possible to store new images by Frame Start Trigger.

This mode is available if Acquisition mode is set at “Continuous”.
This mode can work in EPS mode and PWC mode. This is not available for Sequence Trigger.

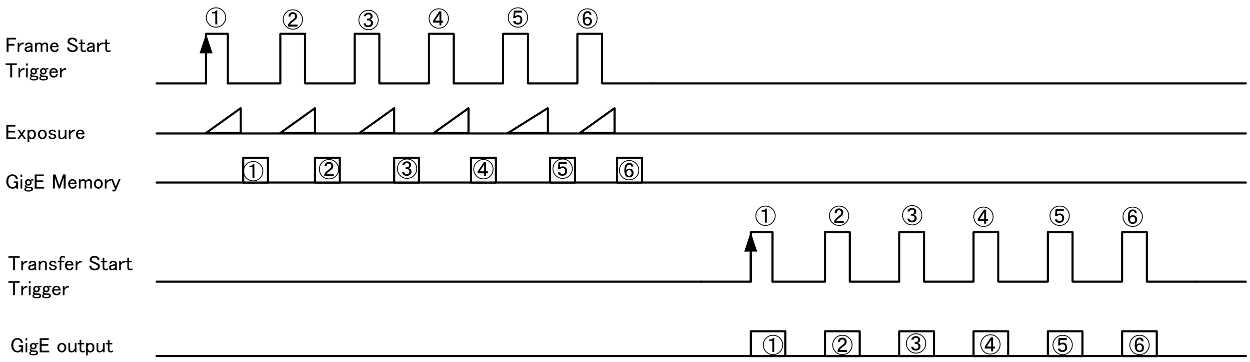
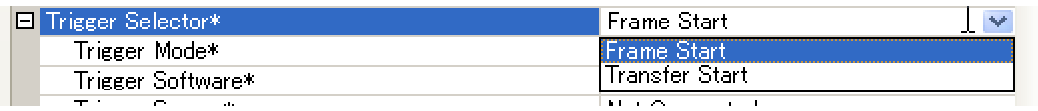


Fig.44 Delayed readout concept drawing

The image is captured the following settings;
Frame start =ON, Trigger mode = ON and Exposure mode = Timed or Trigger Width
Then, the image is moved to “Delayed Readout Mode”,
If Trigger Selector is set to Transfer Start.



10.5.9 Multi ROI mode (Multi Region of Interest)

In this trigger mode, up to 5 ROIs located on one image can be output by one trigger input. By using this mode, the data stream can be smaller.
Each ROI can be overlapped.

Please note that if the accumulated data size is bigger than the data size of 1 frame, the frame rate will be reduced. Also accumulated heights for each ROI should be within 966 lines.

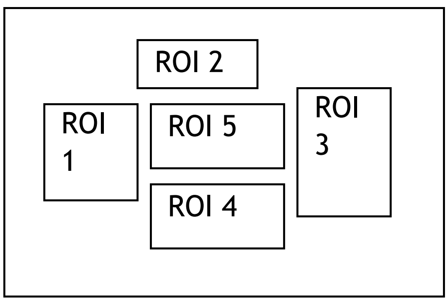


Fig.45 Multi mode concept

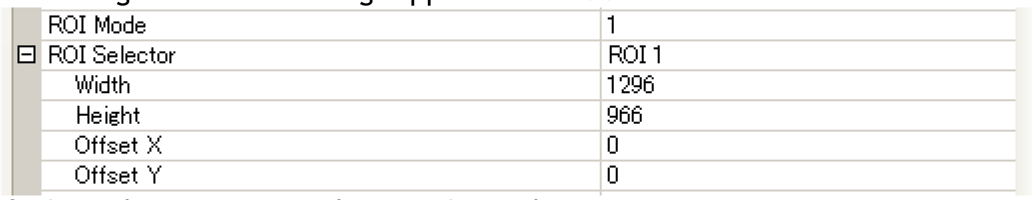
10.5.9.1 Setting parameters

In order to execute Multi ROI operation, it is necessary to set ROI mode and ROI size and offset.

ROI Mode:
Can be set 1 to 5. This sets the number of ROIs. For multi ROI operation, this should be set from 2 to 5. A total of 5 ROI can be set.
ROI Selector:

In ROI Selector, there is ROI 1 to 5 and each has Width, Height, Offset X and Offset Y settings.

The following is how the settings appear in the GUI.



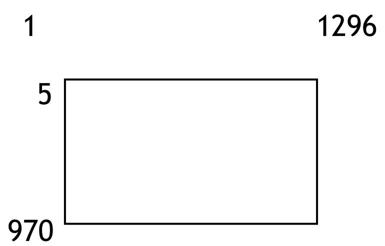
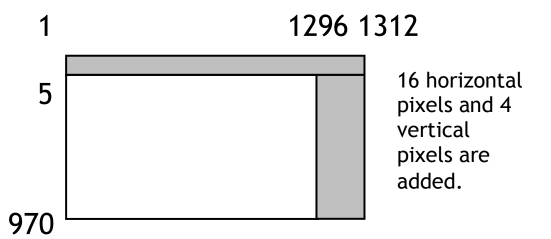
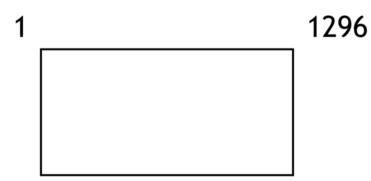
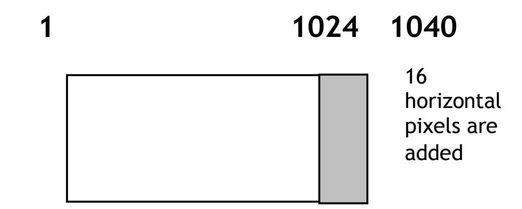
If ROI Mode is set to 1, only one ROI can be set.
In order to use Multi ROI, it should be set at 2 or more. A maximum of 5 ROIs can be set. The size for each ROI can be set by ROI selector.

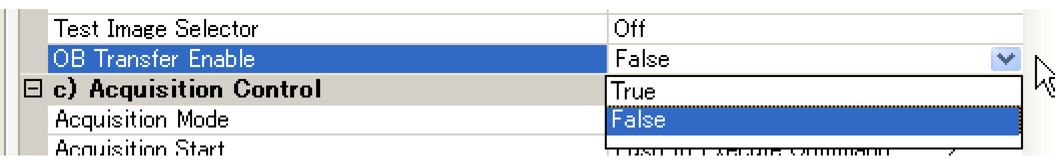
10.5.9.2 Initial parameters

	Camera 0				Camera 1			
ROI Mode	1				1			
ROI Selector	Width	Height	Offset X	Offset Y	Width	Height	Offset X	Offset Y
ROI 1	1296	966	0	0	1296	966	0	0
ROI 2	1296	966	0	0	1296	966	0	0
ROI 3	1296	966	0	0	1296	966	0	0
ROI 4	1296	966	0	0	1296	966	0	0
ROI 5	1296	966	0	0	1296	966	0	0

10.5.10 Optical Black transfer mode

It is possible for the user to decide whether the optical black (OB) portion of the image will be transferred or not. The optical black part can be used for black reference in the application software. Setting register 0xA41C turns the optical black transfer ON or OFF. The default condition is OFF.

	OB Transfer Mode OFF	OB Transfer Mode ON
Full		
JAI Partial Scan		



10.6. Operation Mode and Functions matrix

10.6.1. Sync Mode = SYNC

Sensor		AD-130GE #0 Bayer(channel1)			AD-130GE #1 Monochrome(channel2)			Auto Iris output (note2)
Trigger Input		Trigger 1 : Valid			Trigger 2 : Invalid			
Mode		Shutter	Partial	Smear less	Shutter	Partial	Smear less	
1	Continuous	Yes	Yes	No	Yes	← (note1)	No	Yes(*2)
2	Edge Pre-select (EPS)	Yes	Yes	Yes	Yes	←	←	No
3	Pulse Width Control (PWC)	Not applicable	Yes	Yes	Not applicable	←	←	No
4	RCT	—	—	—	—	—	—	—
5	Sequential EPS	Yes	Yes	Yes	Yes	Yes	Yes	No
6	Delayed Readout EPS	No	Yes	Yes	Yes	←	←	No
7	Delayed Readout PWC	No	Yes	Yes	No	←	←	No

Note 1: "←" means that the setting depends on channel 1.
Note 2: Video signal for auto iris uses the output can be selected in Iris Signal Output Mode.
Note 3: If Sync mode is set to Sync, RCT is not available.

10.6.2 SYNC Mode = Async

Sensor		Bayer(channel1)			Monochrome(channel2)			Auto Iris output (note2)
Trigger Input		Trigger 1 : Valid			Trigger 2 : Invalid			
Mode		Shutter	Partial	Smear less	Shutter	Partial	Smear less	
1	Continuous	Yes	Yes	No	Yes	Yes	No	Yes (*2)
2	Edge Pre-select (EPS)	Yes	Yes	Yes	Yes	Yes	Yes	No
3	Pulse Width Control (PW)	Not applicable	Yes	Yes	Not applicable	Yes	Yes	No
4	RCT	Yes	Yes	Automatically ON	Yes	Yes	Automatically ON	Yes(*2)
5	Sequential EPS	Yes	Yes	Yes	Yes	Yes	Yes	No
6	Delayed Readout EPS	Yes	Yes	Yes	Yes	Yes	Yes	No
7	Delayed Readout PWC	No	Yes	Yes	No	Yes	Yes	No

Note 1: "←" means that the setting depends on channel 1.
Note 2: Video signal for auto iris uses the signal can be selected in Iris Signal Output Mode.

11. Other functions

11.1. Basic functions

The AD-130GE is based on a dichroic prism, allowing precise separation of the visible (color) and near-infrared parts of the spectrum into two separate channels. The visible (color) channel is referred to as Channel 1 and the near-infrared channel is referred to as Channel 2. Channel 1 and 2 can be configured to operate separately or synchronously. When operating separately each channel can be triggered independently.

The AD-130GE can operate in Continuous (free-run) mode or in triggered modes.
The variable partial scan mode provides higher frame rates at lower vertical resolution.

11.1.1 2CCD optical assembly

The dichroic prism incorporated in the AD-130GE separates the visible (color) part of the spectrum into a wavelength band from 400nm to 650nm (Channel 1) and the near-IR part into a band ranging from 760 nm to 1000 nm (Channel 2).
The figure below shows the concept of the separation into visible and near-IR bands.

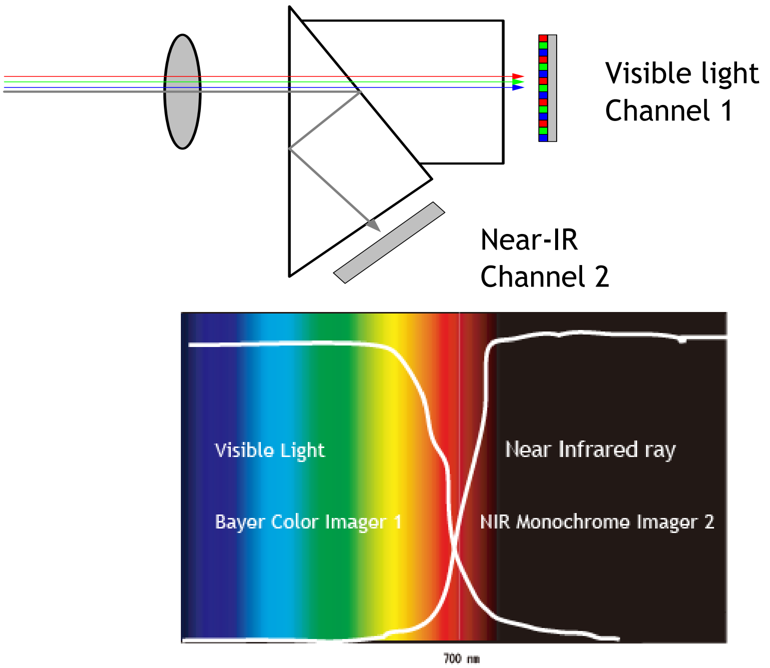


Fig.46 Conceptual diagram for 2CCD prism optics

11.1.2 Electronic shutter

The AD-130GE has three shutter modes: programmable exposure, GenICam standard Exposure Time Abs, and auto shutter.

Exposure Time Abs (GenICam Standard)

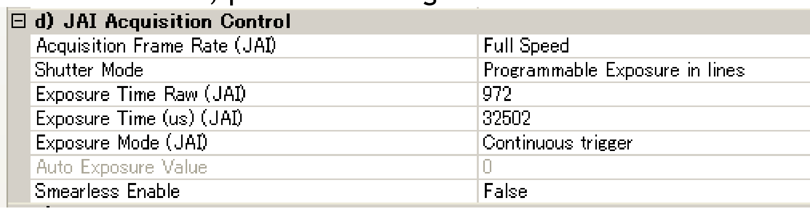
This is a function specified in the GenICam standard.
The shutter speed can be entered as an absolute exposure time in microseconds (μs) in register address 0xA018. The entered absolute time (Time Abs) is then converted to programmable exposure (PE) value inside the camera.

The calculating formula below shows the relationship between the PE values used by the

camera for the different readout modes.
Due to rounding down of calculations, some discrepancies may occur.

The relation between PE value and Time Abs
Normal readout PE= INT (Exposure time) µs / (1660/51324000)
(Note: INT means round down.)
Note:The minimum value in normal readout is 16µs.

In the AD-130GE, previous settings are also available in JAI Acquisition Control.



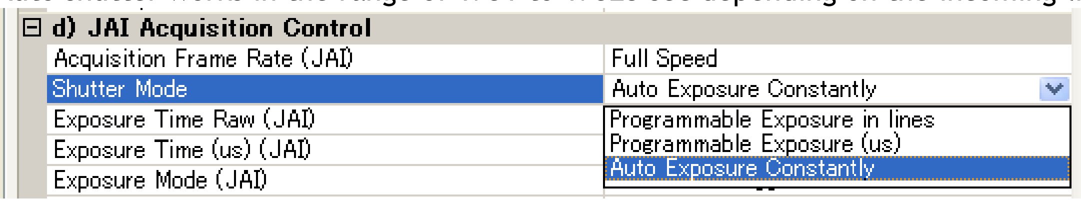
d) JAI Acquisition Control	
Acquisition Frame Rate (JAI)	Full Speed
Shutter Mode	Programmable Exposure in lines
Exposure Time Raw (JAI)	972
Exposure Time (us) (JAI)	32502
Exposure Mode (JAI)	Continuous trigger
Auto Exposure Value	0
Smearless Enable	False

Programmable Exposure
Exposure time can be controlled in 1 L unit (32.344µs) from 0L to 982L. As the overhead of 0.4L is added, the actual shutter time is from 0.4L to 982L in the range from 0.4L to 982L. 982 L is the shutter OFF. The actual shutter speed for each operation mode is shown below.

Mode	Read Out	Minimum shutter speed	Maximum shutter speed
Continuous, EPS/RCT	Full, Partial	11.49µs (=1/87000s)	1 Frame
PWC	Full, Partial	32.344µs x 2L+11.49µs(0.4L)= 76.111µs (approx. 1/13,000s)	60 Frames (2 seconds)

Note: In Pulse Width mode, the minimum trigger pulse width must be >2LVAL.

Auto shutter
Auto shutter works in the range of 1/31 to 1/325 sec depending on the incoming light.



d) JAI Acquisition Control	
Acquisition Frame Rate (JAI)	Full Speed
Shutter Mode	Auto Exposure Constantly
Exposure Time Raw (JAI)	Programmable Exposure in lines
Exposure Time (us) (JAI)	Programmable Exposure (us)
Exposure Mode (JAI)	Auto Exposure Constantly

GPIO in combination with Pulse Width trigger
More precise exposure time can be obtained by using GPIO in combination with Pulse Width mode. The clock generator and counter can be programmed in very fine increments.

11.1.3 Shading correction

The AD-130GE features a shading correction circuit that can be used for reducing shading resulting from illumination, lens vignetting or prism shading caused by lenses with a wide output aperture.
The shading correction circuit divides the image into horizontal and vertical fields, and adjusts these regions in relationship to the image center.
In the internal memory, factory data is stored. When the shading correction is ON, factory data is loaded.
If it is OFF, the calibration can be activated and the result can be stored in the user area for reuse. Each channel is treated separately. The shading correction works with all pixel formats, raw Bayer color, RGB color and monochrome.

11.1.4 White balance

When using the RGB 24-bit and RGB 30-bit output mode, the white balance function is available. It can be used in 3 ways:

1) Continuous (tracking) Automatic White Balance, AWB
2) One-push AWB
3) Manual white balance setting

Manual white balance is achieved by optimizing the manual gain settings for R channel and B channel.

Items	Continuous (tracking) AWB(1)	One-push AWB(2)	Manual WB
Adjusting range	-7dB to +10dB	-7dB to +10dB	-7dB to +10dB
Possibility to store WB settings	No	Yes	Yes

1): When using Continuous AWB, results depend on the surface properties of the object.
2): One-push AWB may take up to 3 seconds to complete.

White Balance Measuring area

The user can select from the following 64 areas to use for detecting the area of white balance measurement. Each one or accumulated areas making rectangular shape as shown can be selected at the same time and if the entire area is used for white balance detection, all 64 areas can be selected.

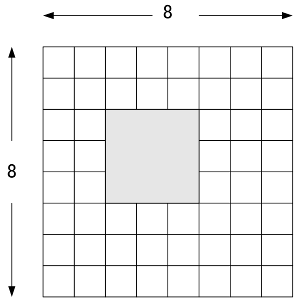


Fig.47 White balance detecting area

11.1.5 Blemish compensation

The AD-130GE has a blemish compensation function.
In the factory, the data for blemish compensation is stored in the factory data. When the blemish compensation is set to ON, the factory data is loaded. The user can store the compensation data in the user area (1 to 3). When executing a blemish compensation, it can be done for white and black blemishes. The user can also set the threshold of detecting blemishes. Up to 32 blemishes can be compensated.

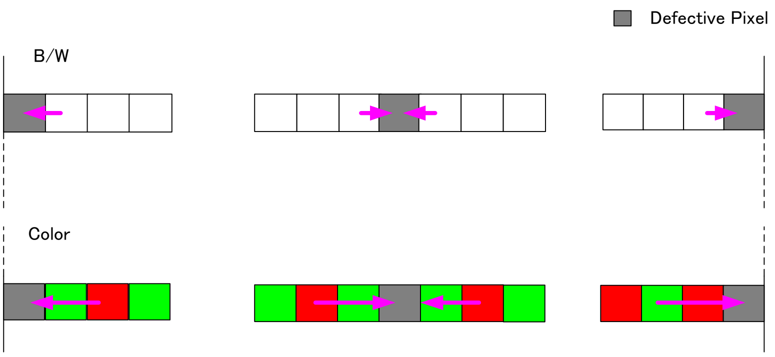


Fig 48. Blemish compensation

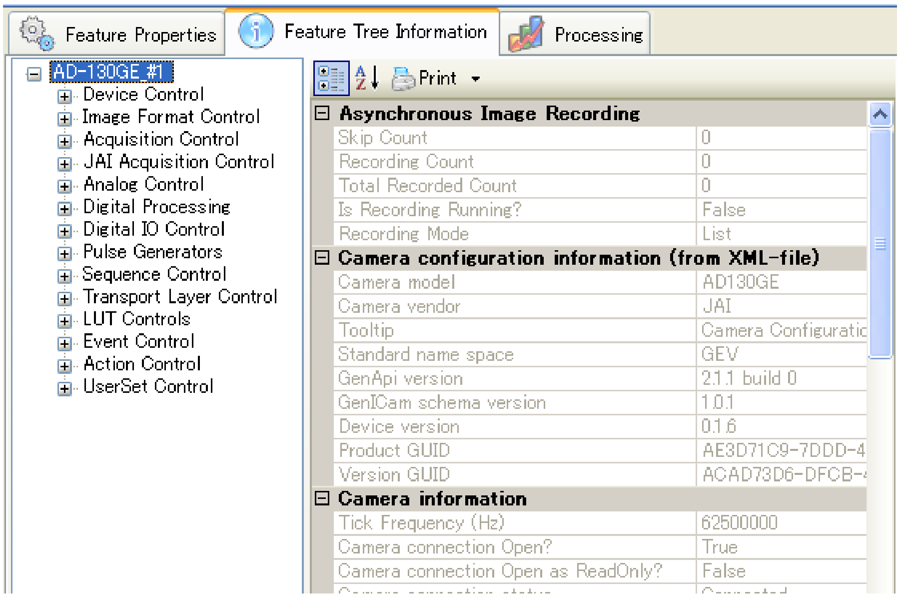
11.1.6 Test signal generator

The AD-130GE has the following test generators built-in.

Address	Function	Read/Write	Size	Value
0xA13C	Test stream	RO	4	0=OFF 4=H Ramp scale 5=V Ramp scale 6=Moving Ramp scale 8=Color bar (Normal) 9=Color bar (Vertical) 10=Moving color bar

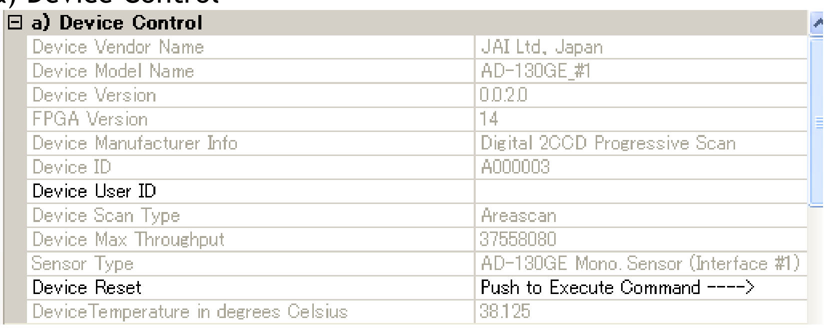
11.2. Control Tool Screen

11.2.1 Feature Tree Information



11.2.2 Feature Properties (Guru)

a) Device Control



b) Image Format Control

AD-130GE #0 (Color)

b) Image Format Control	
Pixel Format	8 Bit BAYRG
Sensor Width	1296
Sensor Height	966
Sensor Taps	One
Sensor Digitization Taps	One
Width Max	1296
Height Max	966
ROI Mode	1
ROI Selector	ROI 1
Line Pitch	1296
Sync Mode	Async
JAI Partial Scan	False
Test Image Selector	Off
OB Transfer Enable	False

AD-130GE #1 (IR)

b) Image Format Control	
Pixel Format	8 Bit Monochrome
Sensor Width	1296
Sensor Height	966
Sensor Taps	One
Sensor Digitization Taps	One
Width Max	1296
Height Max	966
ROI Mode	1
ROI Selector	ROI 1
Width	1296
Height	966
Offset X	0
Offset Y	0
Line Pitch	1296
JAI Partial Scan	False
Test Image Selector	Off
OB Transfer Enable	False

c) Acquisition Control

c) Acquisition Control	
Acquisition Mode	Continuous
Acquisition Start	Push to Execute Command ---->
Acquisition Stop	Push to Execute Command ---->
Trigger Selector*	Frame Start
Trigger Mode*	Off
Trigger Software*	Push to Execute Command ---->
Trigger Source*	Line5 - Optical In 1
Trigger Activation*	Rising Edge
Trigger Source Inverter	False
Exposure Mode	Timed
Exposure Time	32290
Exposure Time (us)	32290
Exposure Time (Raw)	972
Pre-dump Mode	Off

d) JAI Acquisition Control

d) JAI Acquisition Control	
Acquisition Frame Rate (JAI)	Full Speed
Shutter Mode	Programmable Exposure in lines
Exposure Time Raw (JAI)	972
Exposure Time (us) (JAI)	32502
Exposure Mode (JAI)	Continuous trigger
Auto Exposure Value	0
Smearless Enable	False

e) Analog Control

AD-130GE #0 (Color)

e) Analog Control	
Gain Selector	Analog All
Gain Auto	Off
AGC Reference	0
Auto Gain Value	0
Black Level Selector	All
Balance White Auto	Off
JAI Balance White Auto Once	Push to Execute Command ---->
Status of video processing	Completed successfully
AWB Area Selector	Block0
AWB Area Enable All	65535
Iris Signal Output Mode	CCD1
ASC Min.	95
ASC Max.	792
ASC Speed	8
AGC Min.	0
AGC Max.	593
AGC Speed	8

AD-130GE #1 (IR)

e) Analog Control	
Gain Selector	Analog All
Gain (Raw)	0
Gain Auto	Off
AGC Reference	0
Auto Gain Value	0
Black Level Selector	All
Black Setup Level (Raw)	512
Status of video processing	Completed successfully

f) Digital Processing

f) Digital Processing	
Gamma Selector	Mono/Bayer
Gamma Set	1.0
Shading Correction Enable	False
Shading Correction Mode	Flat Shading
Perform Flat Shading Calibration	Push to Execute Command ---->
Blemish Reduction Enable	Disable
Perform Black Blemish Reduction Calibration	Push to Execute Command ---->
Perform White Blemish Reduction Calibration	Push to Execute Command ---->
Knee Enable	False
Knee Selector	Mono/Bayer
Knee Slope	2347
Knee Point	6864

g) Digital Control

g) Digital IO Control	
Line Selector	Line1 - TTL Out 1
Line Source	Off
Line Inverter	False
Line Status	False
Line Mode	Output
Line Format	TTL
Line Status All	128
User Output Selector	User Output 0
User Output Value	False
User Output Value All	0
Software Trigger 0	0
Software Trigger 1	0
Software Trigger 2	0
Software Trigger 3	0

h) Pulse Generator

h) Pulse Generators	
Clock Pre-scaler	1
Pulse Generator Clock (MHz)	33.75
Pulse Generator Selector	Pulse Generator 0
Pulse Generator Length	1
Pulse Generator Length (ms)	2.963E-05
Pulse Generator Frequency (Hz)	3.375E+07
Pulse Generator Start Point	0
Pulse Generator Start Point (ms)	0
Pulse Generator End Point	1
Pulse Generator End Point (ms)	2.963E-05
Pulse Generator pulse-width (ms)	2.963E-05
Pulse Generator Repeat Count	0
Pulse Generator Clear Activation	Free Run
Pulse Generator Clear Source	Off
Pulse Generator Inverter(Polarity)	False

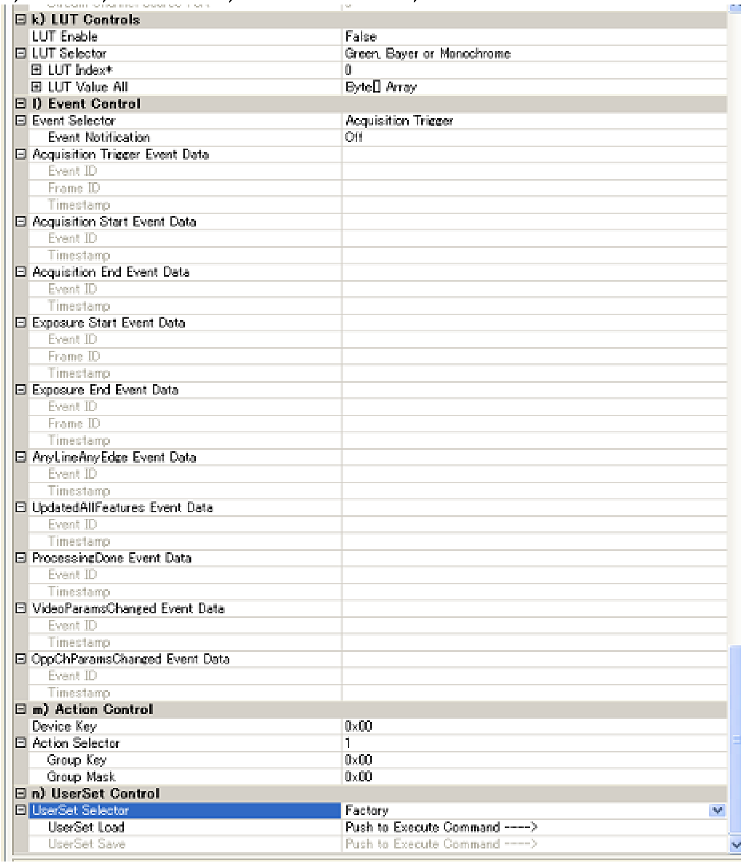
i) Sequence Control

i) Sequence Control	
Sequence Mode	Off
Sequence Repetition Count	0
Last Sequence	1
Sequence Selector	Sequence 1
Repeat Count in Each Step	1
Sequence Exposure Time Raw	0
Sequence Master Gain Raw	-1
Sequence ROI Size X	1296
Sequence ROI Size Y	966
Sequence ROI Offset X	0
Sequence ROI Offset Y	0
Reset Sequence Settings	Push to Execute Command ---->

j) Transport Layer Control

j) Transport Layer Control	
Payload Size	1251936
GigE Vision Major Version	1
GigE Vision Minor Version	1
Is Big Endian	True
Character Set	UTF8
Interface Selector	0
MAC Address	00-0C-DF-03-F0-E2
Supported LLA	True
Supported DHCP	True
Supported Persistent IP	True
Current IP Configuration LLA	True
Current IP Configuration DHCP	True
Current IP Configuration Persistent IP	False
Current IP Address	169.254.1.210
Current Subnet Mask	255.255.0.0
Current Default Gateway	0.0.0.0
Persistent IP Address	192.168.100.2
Persistent Subnet Mask	255.255.255.0
Persistent Default Gateway	0.0.0.0
GigE Vision Supported Option Selector	Link Local Address configuration
Supported Option	True
First URL	Local:JAI_AD-130GE_1_Ver016.zip;243F0000;9a60
Second URL	
Number Of Interfaces	1
Message Channel Count	1
Stream Channel Count	1
Supported Optional Commands EVENTDATA	False
Supported Optional Commands EVENT	True
Supported Optional Commands PACKET RESEND	True
Supported Optional Commands WRITEMEM	True
Supported Optional Commands Concatenation	True
Heartbeat Timeout	40000
Timestamp Tick Frequency	62500000
Timestamp Control Latch	Push to Execute Command ---->
Timestamp Control Reset	Push to Execute Command ---->
Timestamp Tick Value	0
Control Channel Privilege	ControlAccess
Message Channel Port	1296
Message Channel Destination Address	169.254.181.73
Message Channel Transmission Timeout (ms)	300
Message Channel Retry Count	2
Message Channel Source Port	1296
Stream Channel Selector	0
Stream Channel Port	0
Do Not Fragment	True
Packet Size	1476
Packet Delay*	2000
Stream Channel Destination Address	0.0.0.0
Stream Channel Source Port	0

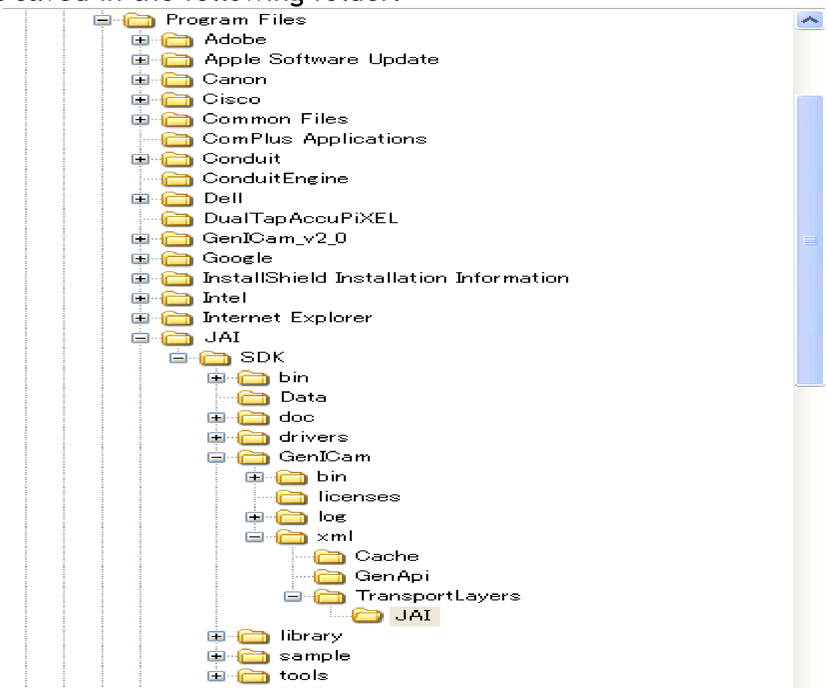
k) LUT l) Event m) Action and n) User Controls



How to check XML file

All functions and registers are stored in the camera as XML file.

The XML is saved in the following folder.



12. External Appearance and Dimensions

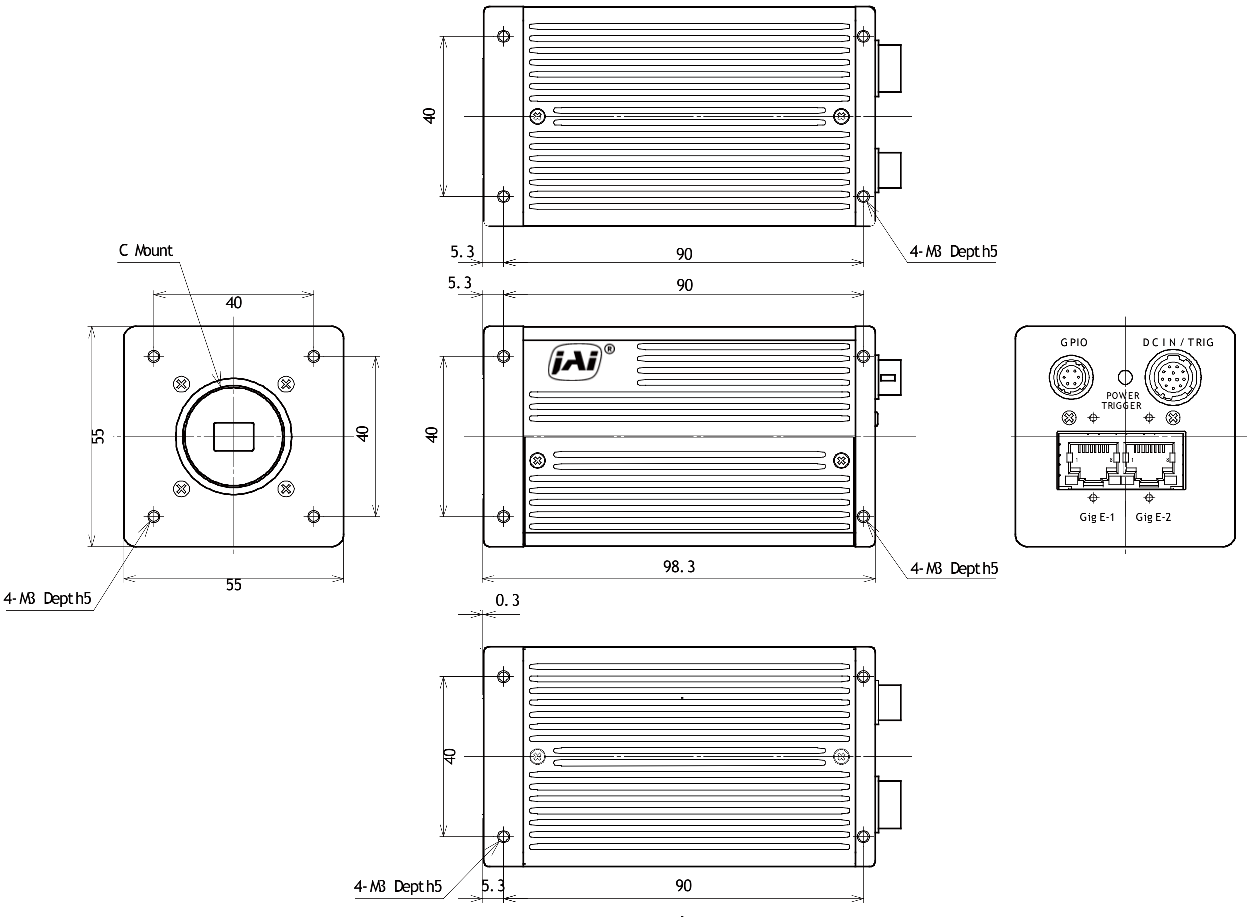


Fig. 49 Dimensions

13. Specifications

13.1. Spectral response

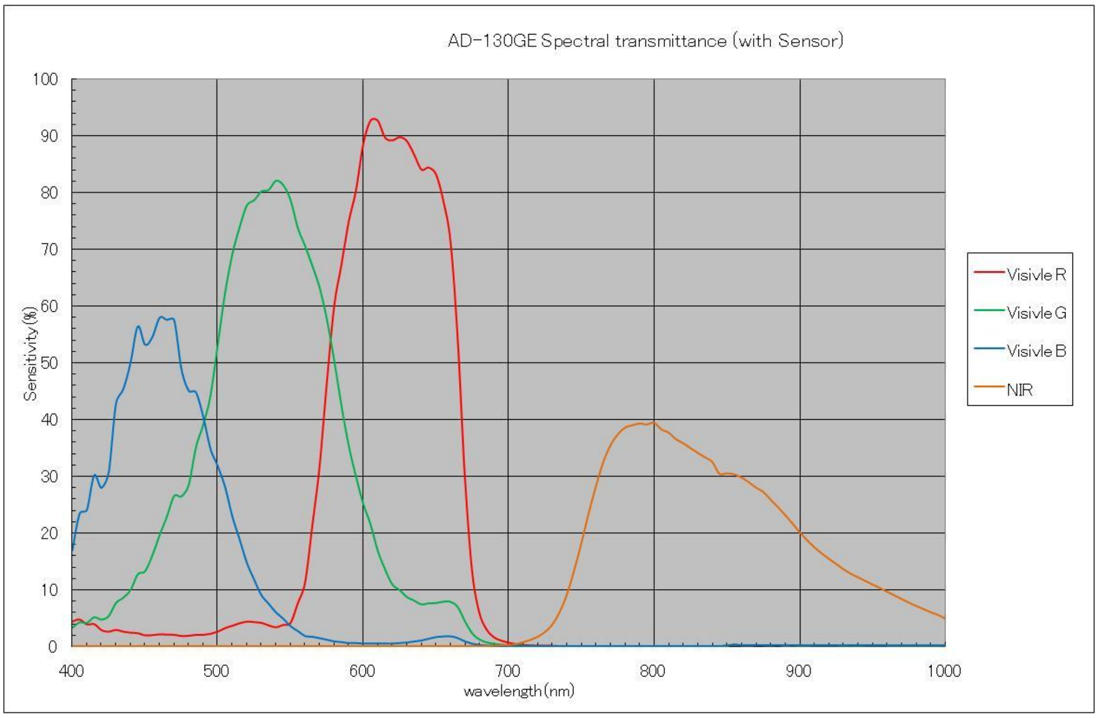


Fig. 50 Total spectral response including prism and sensor (Monochrome IR)

13.2. Specification Table

Specifications	AD-130GE	
	Color Imager channel	Monochrome Near-IR Imager ch.
Optical system	1/3 inch type F2 prism	
Scanning system	Progressive scan	
Synchronization	Int. X-tal	
Frame Rate Full scan	31.484 frames / sec. Progressive (966 lines/frame)	
Pixel clock	51.324MHz	
Line frequency	30.918 KHz (1660 pixel clocks / line)	
Image sensor	1/3 inch Bayer color IT CCD ICX447	1/3 inch Monochrome IR IT CCD ICX447
Sensing area	4.86 (H) x 3.63 (V) mm	
Cell size	3.75 (H) x 3.75(V) µm	
Active pixels	1296(H) x 966 (V)	
Pixels in Video output Full Partial	1296 (h) x 966 (v) 31.484 fps. H = 30.918 kHz Scan height 8 to 966 lines, In conjunction with ROI, if JAI Partial Scan is set to ON, Offset Y and Height is automatically set.	
Output readout	Sync / async (Color and IR outputs readout) selected by Sync mode	
Sensitivity on sensor	0.4 lux Max. Gain, Shutter OFF, 50% Video Level	0.02 µW / cm^2 at 800nm Max. Gain, Shutter OFF, 50% Video Level, F2.2
S/N (dB)	More than 52dB (G-ch, 0dB) 10bit	More than 54 dB (0dB) 10bit
Iris video output, Analog	0.7 V p-p (without Sync)	
Digital Video Output	Via RJ-45-1(GigE1) BayRG8, BayRG10, BayRG12, RGB8Packed , RGB10V1_Packed, RGB10V2_Packed	Via RJ-45-2 (GigE2) Mono8, Mono10, Mono10_Packed, Mono12_Packed, Mono12
White balance	Gain range: -7dB to +10dB Manual: 2800K to 9000K One-push: 2800K to 9000K Continuous: 2800K to 9000K Fixed: 3200K,4600K,5600K	Not applicable
Input signals	(TTL/75Ω) x2, LVDS x 1 Hirose 6 pin OPT x2 HIROSE 12-pin	
Output signals	TTL x 1 Hirose 6 pin OPT x 2 Hirose 12 pin	
Gain	1) Master Gain: 0dB to +21dB R,B Gain : -7dB to +10dB 2) AGC: 0dB to +21dB	1) Master Gain: -3dB to +21dB 2) AGC: 0dB to +21dB
LUT/Gamma	1.0/0.6/0.45/LUT	
Shading compensation	ON/OFF (Color RGB and Mono) Color: Color and flat shading, IR : Flat shading	
Blemish compensation	Built in	
GPIO Module Input /Output switch Clock Generator(one) Pulse generator (Four)	Configurable 14-in / 32-out switch 12 bit counter based on pixel clock 20-bit counter programmable for length, start point, stop point , repeat	
Hardware Trigger mode	Edge Pre-select, Pulse width control, RCT, Frame delay, Sequence	
OB area transfer mode	ON / OFF In case of ON, 970 lines in vertical and 1312 clocks in horizontal are output.	
Event message	Exposure start, Exposure end, Trigger IN, Video start, Video end	

Electronic Shutter Exposure Time Abs Pulse width control GPIO plus Pulse width Auto shutter	 11.49 μs to 31.761ms(0.4L to 982L in 1L step) 1/13,000(2.4L) to Max. 2 sec fine setting with GPIO and pulse width control 95L to 982L
Accumulation	LVAL synchronous or LVAL asynchronous automatic selection or manual
Control interface	Gigabit Ethernet (IEEE802.3, ATA GigE Vision Standard) 2 lines
Functions controlled via GigE Vision Interface	Shutter, Gain, Black Level, Trigger mode, Read out mode, GPIO setup, ROI (GenICam mandatory functions)
GigE Vision Streaming Control	Packet size, Delayed (Frame) read-out, inter-packet delay Jumbo frame can be set at max. 16K (16020), Default packet size is 1476 Byte.
Indicators on rear panel	Power, Hardware trigger, GigE Link, GigE activity
Lens Mount	C-Mount (Rear protrusion less than 4mm). Designed for 3CCD camera
Flange back	17.526mm Tolerance 0 to -0.05mm
Operating temperature	-5°C to +45°C
Operating humidity	20 to 80% (non-condensing)
Storage temperature/humidity	-25°C to +60°C / 20% to 80% (non-condensing)
Vibration	3G (15Hz to 200Hz XYZ)
Shock	50G
Regulatory	CE (EN61000-6-2, EN61000-6-3), FCC Part 15 Class B, RoHS
Power	DC +10.8V to +26.4V, 8.0W (Typical, normal operation, +12VDC in) 8.7W(8 lines partial scan, +12VDC in)
Dimensions	55 (H) x55 (W) x 98.3(D) mm
Weight	340 g

Note: Above specifications are subject to change without notice.
Note: *Approximately 30 minute pre-heat required to meet specifications.*

Appendix

1. Precautions

Personnel not trained in dealing with similar electronic devices should not service this camera. The camera contains components sensitive to electrostatic discharge. The handling of these devices should follow the requirements of electrostatic sensitive components.
Do not attempt to disassemble this camera.
Do not expose this camera to rain or moisture.
Do not face this camera towards the sun, extreme bright light or light reflecting objects, including laser sources.
When this camera is not in use, put the supplied lens cap on the lens mount.
Handle this camera with the maximum care.
Operate this camera only from the type of power source indicated on the camera.
Remove power from the camera during any modification work, such as changes of jumper and switch settings.

2. Typical Sensor Characteristics

The following effects may be observed on the video monitor screen. They do not indicate any fault of the camera, but do associate with typical sensor characteristics.

V. Aliasing
When the camera captures stripes, straight lines or similar sharp patterns, jagged image on the monitor may appear.

Blemishes
All cameras are shipped without visible image sensor blemishes.
Over time some pixel defects can occur. This does not have a practical effect on the operation of the camera. These will show up as white spots (blemishes).
Exposure to cosmic rays can cause blemishes to appear on the image sensor. Please take care to avoid exposure to cosmic rays during transportation and storage. It is recommended that sea shipment instead of air flight be used in order to limit the influence of cosmic rays on the camera. Pixel defects/blemishes also may emerge due to prolonged operation at elevated ambient temperature, due to high gain setting or during long time exposure. It is therefore recommended to operate the camera within its specifications.

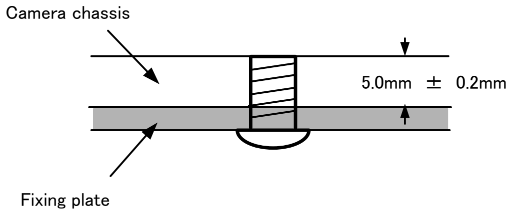
Patterned Noise
When the sensor captures a dark object at high temperature or is used for long time integration, fixed pattern noise may appear in the image.

3. Caution when mounting a lens on the camera

When mounting a lens on the camera, dust particles in the air may settle on the surface of the lens or the image sensor of the camera. It is therefore important to keep the protective caps on the lens and on the camera until the lens is mounted. Point the lens mount of the camera downward to prevent dust particles from landing on the optical surfaces of the camera. This work should be done in a dust free environment. Do not touch any of the optical surfaces of the camera or the lens.

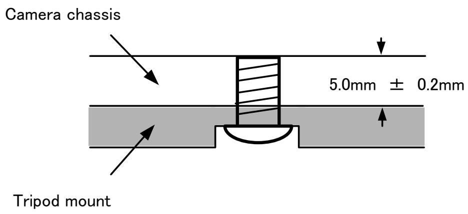
4. Caution when mounting the camera

When you mount the camera on your system, please make sure to use screws of the recommended length described in the following drawing. Longer screws may cause serious damage to the PCB inside the camera.



Mounting the camera to fixing plate

If you mount the tripod mounting plate, please use the provided screws.



Attaching the tripod mount

5. Exportation

When exporting this product, please follow the export regulation of your own country.

6. References

1. This manual for AD-130GE can be downloaded from www.jai.com
2. Datasheet for AD-130GE can be downloaded from www.jai.com
3. JAI SDK software can be downloaded from www.jai.com

Change History

Month/Year	Revision	Changes
Feb. 2012	1.0	New issue
Mar. 2012	1.1	Delete color matrix, Correct the horizontal timing chart Correct offset and height figures in the partial scan

User's Record

Camera type: **AD-130GE**

Revision: ……………..

Serial No. ……………..

Firmware version. ……………..

For camera revision history, please contact your local JAI distributor.

User's Mode Settings.

User's Modifications.

Europe, Middle East & Africa	*Asia Pacific*	*Americas*
Phone +45 4457 8888 *Fax +45 4491 3252*	*Phone +81 45 440 0154* *Fax +81 45 440 0166*	*Phone (toll-free) +1 800 445 5444* *Phone +1 408 383 0300*

Visit our web site at www.jai.com

See the possibilities